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SeisTool Ver. 2.1 User's Guide

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Preface

SeisTool is an interactive graphical tool that allows you to analyse seismograms. It runs under the X window environment. The current version employs an OpenLook graphical user interface. It is designed for convenient display of seismograms and handling of events for routine analysis. It also allows phase picking to be done smoothly. A number of time-series analysis operations have also been implemented.

Here, I attempt to provide a brief guide to the operation of SeisTool. The intention of this *User's Guide* is not to guide you through SeisTool step by step. (The best way of learning how to use SeisTool is run the program and experiment with it.) However, I shall present here a few basic concepts behind SeisTool to acquaint you with the program.

My goal of this prototype is to make analysing seismograms as easy and convenient as browsing a file with a text editor. I prefer to think of SeisTool as nothing more than a seismogram data file browser.

U.C. Berkeley
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A. K. Yu

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A large part of the time-series analysis code has been supplied by Lind Gee who is deeply acknowledged. I would also like to thank her for verifying the correctness of the operations by comparing them with her own analysis package, *gfs_proc*.

I also would like to thank Greg Anderson, Doug Dreger, Ann Kirkpatrick, Rick McKenzie and Robert Uhrhammer for their patience in testing the software with routine analysis and research projects. I would like to thank particularly Doug Neuhauser and John Peterson for their helpful discussions and advice throughout the development of SeisTool.

I would like to thank Ernie Majer for the support and the dedicated hardware which made the whole project possible. I would also like to thank Barbara Romanowicz for her trust in adopting SeisTool for routine analysis and all the staff at both the Center for Computational Seismology and Seismographic station who have been involved in the project for their kindness, patience and guidance.

Chapter 1

General

SeisTool is designed to be easy to use. With the graphical user interface, most of the operations should be self-explanatory. Also, since the program uses most of the standard OpenLook widgets, a user familiar with the OpenWindows environment or OpenLook applications should have no difficulty in using it.

This chapter familiarizes you with the basics of SeisTool. It explains the internal structure of SeisTool (eg. the Event Queue Manager and the Trace Manager) and the different operation modes. You might want to skim through the sections on Internal Structures and Operation Modes since you don't need to understand everything in those sections before using SeisTool.

1.1 Using SeisTool

1.1.1 Getting Started

To start up SeisTool, invoke `seistool` at a unix prompt like the following:

```
% seistool [options ...] [filenames ...]  
Initializing...
```

When SeisTool starts up, it goes through a bunch of initialization procedures. You will notice dots being outputted as it goes along. Each of the dots represents completion of a stage in the following order: X initialization, XView objects initialization and loading of fonts. A detailed description of the different options can be found in the *seistool* reference manual page in the Appendix.

Fig. 1 shows a normal session of SeisTool: the main window displays the traces in a data file and part of the traces are enlarged and displayed in the zoom window. The buttons panel comes with the zoom window.

Figure 1: The main window and zoom window

1.1.2 Customizing SeisTool

When SeisTool starts up, it looks for an optional init file. It searches the current directory for a file named `.seistool-init`. If such file does not exist, the home directory is also searched. The contents of the file are the default settings of your choice. It can be anything from the number of traces to be displayed to the position of the windows where they should come up. A detailed description of the available settings can be found in the *seistool-init* reference manual page in the Appendix.

1.2 Internal Structure

1.2.1 Trace Manager

The trace manager handles traces of the current event. The traces may come from a single file as well as different data files. Once the traces are all loaded in, there are considered to be part of the current event.

Internally, the current event is stored as an array of traces. The array can contain any number of traces. The trace manager handles adding, removing and reordering of the traces.

The main window can be considered as a browser of the traces array. Most of the time, you will only see a portion of the array as the number of traces loaded in is usually more than the number of traces to be displayed.

1.2.2 Event Queue Manager

In a single session, SeisTool may be used to analyse different events. The events might have been specified at start up time (on the command line) or through the *Load event* menu. (Note that once the event list file is read, the existence of the event file is forgotten.)

Only one event (the *current event*) is active at any one time. All the traces in the current event are loaded into core memory and managed by the trace manager. Traces in inactive events remain on disk.

Internally, SeisTool keeps a doubly linked list of events. A list of filenames containing the data is kept for each event. Such information is used to determine which traces need to be loaded in for the current event. With the event queue, you can visit events in sequence, back and forth or in any desired order.

1.3 Operation Modes

There are a variety of operation modes in which SeisTool operates. Most of the time, you do not need to worry about which mode SeisTool is in. But for the benefit of your knowledge, here are the details.

1.3.1 Time Alignment

When SeisTool is in time-aligned mode, the traces are aligned in time. This is useful when displaying traces that have different number of samples (eg. TRC files) or traces that have different first sample time (eg. DBX files). A time scale will also be displayed in the main window.

When time alignment is turned off, the traces are scaled separately. (This is useful when you don't see any traces in the main window after the whole event is loaded in. They may be so far apart in time that each trace is reduced to a tiny dot.)

1.3.2 Triplet Mode

Triplet mode is an addition to make handling of three-component data easier and more robust. The traces are grouped into triplets of a vertical and two horizontals.

¹ This mode is used by travel time display and rotations. (SeisTool automatically groups the traces when you start doing rotations or displaying travel time curves.)

¹the generic terms *vertical* and *horizontal* are used to mean the three components of an instrument in any orientation

The traces are grouped according to their station names, their component names and time requirements. Only traces that have the same station name but different component names,² same sampling rate and (piecewise) overlapping time are grouped together. Furthermore, each triplet contains at most three traces.

When SeisTool is in triplet mode, traces displayed in the zoom window are all in the same triplet. (The number of traces displayed is adjusted automatically so that it is the same as the number of traces in the triplet.)

1.3.3 Other Modes

A variety of other modes is explained in 7.2. They control features like pick style, display of borders, etc.

²Z, v are considered vertical, N, 1, E and 2 are horizontals.

Chapter 2

Events and Traces handling

Handling of data files in different formats and in different groupings is one of the major tasks of SeisTool. The smallest unit SeisTool handles is a *trace*. An *event* is a group of traces. An event can consist of traces from a single data file or traces from multiple data files (in possibly different formats). This chapter explains how traces and events are handled in SeisTool.

2.1 Events

2.1.1 Data File Formats

SeisTool currently support data files in a variety of formats: UW (University of Washington) , TRC ¹ , DBX (Geoscope), BIS ² , SDR (steim-1 compressed SEED data records), SEG Y and SAC (Seismic Analysis Code, LLNL). When specifying a UW file, you can use a filename with any of the following suffixes: p, d or D.

SeisTool is designed so that its operation is not tied to a particular data format. When the files are loaded in, they will be converted to the internal format (which happens to use a BIS header to keep track of the “header” information).

2.1.2 Events in Single File

In some data formats, a single file contains the whole event. For instance, a SEG Y file contains a dozen of traces from the same event. UW, TRC, and possibly BIS formats belong to this category.

To load in such a data file, you can either do it interactively in SeisTool with the *Files* menu (see 2.2.2) or specify the files on the command line when starting up

¹The TRC format is an arcane format used at Lawrence Berkeley Laboratory.

²BIS stands for Berkeley Institute of Seismology. This is the format SeisTool uses internally for keeping the “header” information.

SeisTool. For example, the following load in all the SEG Y data files (as separate events) in the directory, assuming the default format is SEG Y:

```
% seistool *.sgy
```

Alternatively, you may prepare a *file list* file which contains the filenames of the single-event files (see the manual pages in the Appendix for the details) and load it in like this:

```
% seistool -fl list.flf
```

2.1.3 Events in Multiple Files

An event might comprise several files, however. For instance, SDR and SAC data files contain only a single trace. An event is a collection of a bunch of these “traces” files. DBX and BIS ³ formats also belong to this category.

Similar to loading in single event data files, you can either do it interactively in SeisTool (see 2.2.3) or specify the files on the command line when starting up SeisTool. For example, the following load in all components of VBB from stations BKS and STAN as a single event.

```
% seistool { BKS/VBB/* STAN/VBB/* }
```

Alternatively, you can prepare an *event list file* which specifies the grouping of data files (see the manual pages for the format of the event list file) and load it in like this.

```
% seistool -el list.elf
```

2.1.4 Traversing Events

As explained before (in 1.2.2), you can look at events in any order. The simplest way is to sequence through them using the two buttons *Prev evt* and *Next evt* in the main window panel. ⁴

If you don't want to sequence through the files one by one, you can also use the *Event Queue Manager* under the *Files* menu. (see fig. 2) You can then skip events and visit the one you like to look at directly.

³A BIS data file contains one or more traces. Hence it can be in either category.

⁴This way of handling events is inspired by the University of Washington software, *zped*.

Figure 2: The Event Queue Manager

To visit an event, select the filename (note that if there are three trailing dots, the event consists of multiple files) and then press the *Goto* button.

2.2 Loading Traces

2.2.1 The “Files” Menu

Under the *Files* menu, you can load and save traces. Fig. 3 shows the various operations.

2.2.2 Loading in a File

To load in a data file, select the *Load File* option from the *Files* menu. A file selection menu like the one in fig. 4 will pop up. You can then load in any number of data files (with different formats) as you like. Traces from the file are added to the existing collection.

To load in a trace file without retaining the existing traces, select *New Load* from the *Files* menu.

Figure 3: The "files" menu

2.2.3 Loading an Event

To load in an event consisting of one or more data files, create an *event list file* as shown in the Appendix. Then choose *Load event* from the *Files* menu and select the event list file. The traces from the different files specified in the event list file will be loaded in accordingly.

2.2.4 Loading in TRC Files

Since most of the information like sampling rate and station names are not found in a TRC data file,⁵ you need to construct a TRC station list file. When you request to load in a TRC file for the first time, SeisTool will prompt you for the TRC station

⁵A variant of TRC files contain station names and sampling rate in the header. In this case, SeisTool will not prompt for the station list.

list file and possibly, the sampling rate. Those settings will be used for subsequent loading. To simplify this procedure, you can employ a TRC init file (see the Appendix for its format). And to load in a different TRC init file, choose *reinit TRC* from the *Special* menu (See 7.4).

Also, time-aligned mode is recommended as most of the TRC traces don't have the same number of samples.

Figure 4: The file selection menu

2.2.5 Loading in a Pick File

When the pick file name and data file name is different, you will need to load in the pick file manually. To do so, choose *Load picks* from the *Files* menu and select the pick file from the file selection menu.

2.2.6 Discarding and Reloading the Traces

To start loading in data files anew, choose *Close all* from the *Files* menu to discard all the traces. (If there are unwritten changes, SeisTool will prompt for confirmation.) You can also choose *Reload* from the *Files* menu to reload in the current traces.

2.3 The “Edit” Menu

Fig. 5 shows the various sorting, reordering and selection operations in the “Edit” Menu.

Figure 5: The “Edit” menu

Select trace is an elaborate method of selecting traces. You can specify a pattern⁶ for selecting the traces with matching station names. (eg. press *Edit* → *Select trace* → *Enter*, input “*Z” and then do *Edit* → *Select trace* → *select*, all the traces with names ending in Z will be selected.)

Select all selects all the traces in the current event while *Deselect all* deselects all the traces. *Discard selected* throws the selected traces away. *Top selected* rearranges the selected traces so that they come before the unselected traces.

There are also a number of miscellaneous operations. For instance, *Regroup ZNE* regroups the traces in ‘Z’, ‘N’ and ‘E’ order; *Group Comp* groups traces in bunches of verticals and horizontals; and *Restore order* reorders the traces in the order they are loaded.

⁶a pattern is similar to the patterns for filename expansion provided by most unix shells (eg. *sh* and *csh*)

2.4 Saving

2.4.1 Saving Traces

It is also possible to dump the traces to files (see fig. 6). Currently, SeisTool can only write out data files in BIS, SAC and SEG-Y formats. To write all the traces to a file, select *Save File* and the desired format. If there are selected traces, only those are written out. (Consult 3.2.2 for how to select traces.) Otherwise, all the traces are written.

Figure 6: Saving traces

You will be prompted for the filename of the data file to output the traces. Since each SAC file contain a single trace only, you will be prompted for the directory to which all the traces file will be written.

2.4.2 Saving a Pick File

When an event consists of a number of data files, it is more convenient to write out a single pick file rather than a bunch of pick files associated with the separate data files. However, it is difficult to name the pick file and by convention, SeisTool names the pick file after the name of the first data file. The pick files will have pf as suffix. To write out a pick file, press *Write* in the main window.

If the data file is in other people's directory, the pick file might not be written to the same place due to permission restrictions. In that case, SeisTool will attempt to write it out to the current working directory. If that fails too, you need to write out

the pick file manually using *Save picks* under the *Files* menu.

2.5 Advanced Features

2.5.1 Execute Scripts

Sometimes, you might want to apply a set of operations to each trace while they are loaded in. For instance, you might want to deconvolve and filter the traces first before displaying them.

To do so, you can create an *execute script* (see Appendix). You can either set the script with command line argument or set it manually. To set an execute script, choose *Set Exec* from the files menu and select a file as the script. The script will be sourced each time a trace is being loaded in. (In other words, to apply the script to the existing traces, you need to do a *reload*.)

2.5.2 Waveform Database

This is an incomplete facility to look at traces from different events. To bring up the *Waveform Database* menu (as in fig. 7), select *Preview* from the *Files* menu.

Figure 7: The Waveform Database menu

You need to specify an event list file or a file list file under *Event file*. Traces from all the events are used. To read in the traces and construct a "database", press *Read*. You can then select the stations from the list. Pressing *Load Traces* will load in the selected traces. You can also prepare a *station list* file specifying the stations you want. (To select those stations, press *Match*.)

Chapter 3

The Main Window

3.1 The Window

3.1.1 Displaying Traces

The main window (labelled "SeisTool") shows part of the traces being loaded in. There are two modes in which the traces can be displayed: namely, time-aligned and absolute modes. The traces are scaled accordingly. The two modes are designed to handle traces that have disparate first sample time and different number of samples. The scrollbar can be used to scroll through the traces.

For each of the traces in the main window, the name of the trace and the plot of the trace are shown in two separate windows (see fig. 10). The window that contains the name is called the *label window*. Information about a trace can be obtained by bringing up the *Info window* (shown in fig. 8) To do so, press the right mouse button in the label window.

Figure 8: the info window

3.1.2 Borders and the Footer

By default, each trace is bounded by a neatly drawn border (as in fig. 10). However, if you want to display more than a dozen of traces in the main window, you might want to turn off the borders (as in fig. 9). You can do so by using the controls panel or by setting appropriate defaults in your `.seistool-init`. (Refer to the appendix for how to turn off the borders by default.) The following figure shows a main window without the borders.

Figure 9: The main window (without borders)

On the footer, the name of the data file from which the traces are loaded in is shown. In case of multiple files being loaded in, the last one is shown. An asterisk beside the filename indicates that there are changes not written back to the pick file yet.

3.1.3 Time Scale

In time-aligned mode, a time scale is displayed on the bottom of the main window. Unlike the time scales in the zoom window, there is no way to turn the scale off in the main window.

3.2 Manipulating Traces

3.2.1 Pruning the Traces

Sometimes, especially in time-aligned mode, you may want to prune off a portion of the traces so that the desired portion is displayed more prominently.

Figure 10: The main window

A dotted line is shown when you press the middle mouse button in the main window. (see fig. 10) To prune part of the traces away, try the following:

- Press the middle mouse button and drag the dotted line to the desired place where the traces are to be cleaved and pruned off.
- While holding down the middle mouse button, press one of the following:
 - *r* or *right mouse button*: Prune off portions to the right
 - *l* or *left mouse button*: Prune off portions to the left
 - *space*: If the mouse pointer is in the left half, the the portion to the left will be pruned off. Otherwise that to the right will be pruned off.
- The desired portion of the traces should now be shown. To restore the traces to full size, press *f* within the main window.

Note also that the visible portion is re-demeaned. To make the pruning permanent, you can select *Perm clip* from the *Edit* menu. However, the use of permanent pruning should be proceeded with caution. (If you pick phases after a permanent pruning, the indices will not be consistent with the data file.)

3.2.2 Selecting a Trace

Traces are selected by clicking the left mouse button in the label window. When a trace is selected, the label window is highlighted as shown in the figure below. To deselect, click again in the label window. The selection is used by a number of operations such as deconvolution, hard-copying and dumping of traces.

Figure 11: The label window

The trace number is displayed when the label window is highlighted. (eg. trace 1 in fig. 11) You will need this number in various operations like freq-time plots. To obtain the number of samples and the sampling rate (in samples per second), you can hold the ctrl key and right mouse button together in the label window. (eg. trace 3 in the figure).

Traces can be selected by either clicking the label windows directly or using the facilities under the *Edit* menu. (See 2.3 for details.)

3.2.3 Selecting a Time Window

Sometimes, you need to select a portion of the trace. For instance, to plot a spectrum of a trace, you need to specify a time window. To do that, move the mouse pointer to the desired starting position and press the *control* key and left mouse button together. Then drag the mouse pointer to the ending position and release the mouse button (and *control* key). The selected portion will then be highlighted (as shown in fig. 12).

Figure 12: a time window

Sometimes you might want to select a fixed time window (say, 1024 samples) for a few traces. To do that, press the *control* key and click the middle mouse button in the main window. When a panel like the one in fig. 13 comes up, enter the appropriate parameters. Then, at the desired position on the traces, press the *control* key and click the middle mouse button without dragging the mouse pointer. A time window with the desired length will be highlighted.

Window Parameters

Close

Units: samples seconds

Length: 1024

Figure 13: select a time window

Chapter 4

The Zoom Window

4.1 Zooming

4.1.1 Zooming in on a Trace

To zoom in on a trace, press the *Zoom* button in the main window's panel. The part of the traces being zoomed is indicated by a pair of square brackets on the traces in the main Window (see fig. 1). Note, however, it is possible that the traces zoomed are not within the main window. To select which part to zoom in, you can go to the main window and click the left button (at the first trace to be zoomed).

Figure 14: The zoom window

The default number of traces shown in the zoom window is three. It is designed for easy display of three-component records. However, even though the three components are displayed together, there is no direct association among the three. In other words, the zoom window is just showing three consecutive traces, giving an illusion of handling 3-component data. In triplet mode, the traces are indeed associated, however. (See the discussion on triple mode in 1.3.2.)

4.1.2 Auto-scrolling

When the zoom window is scrolled, the traces shown in the zoom window may not correspond to the traces shown in the main window. If auto-scrolling is enabled, the main window will also be scrolled when the traces in the zoom window is outside the range of traces shown in the main window.

4.2 Phase Picking

4.2.1 Picking a Phase

There are in general two styles of picking. One of them closely resembles the University of Washington software *xped*:¹ picks have to be labelled before the next pick can be made. However, when dealing with teleseisms, one might want to just mark the phases without naming them. Hence, the second style (à la SeisTool) allows you to pick without having to label them. It also allows you to name a phase with multiple characters.

- To pick a phase, move the mouse pointer to the desired position and click the left mouse button. (A pick line should appear at the right place.)
- To name a pick, enter one or more of the characters in table 4.1: (note that if the mouse pointer is near a pick, that pick will be named. Otherwise, the most recent pick will be named)
- To adjust a pick (not available in UW pick style mode), move the pointer to the pick (pointing more or less directly on the pick) and click the left mouse button, drag it around and adjust it to the desired place.
- To remove a pick, press the right mouse button

4.2.2 The Status Line

The zoom window is divided into sections (corresponding to the number of traces shown). When the mouse pointer is moved into a section, the information of the

¹The UW pick style is provided in the current release for backward compatibility only.

ST Pick Style		UW Pick Style	
+	first motion up	u	first motion up
-	first motion down	d	first motion down
\	unknown	n	unknown
e	emergent	e	emergent
i	impulsive	i	impulsive
E	emergent	E	emergent
I	impulsive	I	impulsive
others	taken to be part of the phase name	p	P phase
		s	S phase
backsp	delete one char from phase name		

Table 4.1: Keyboard Action

corresponding trace will be shown on the status line. It contains the name of the trace, the time and amplitude at the place to where the mouse pointer points. It also shows the *index* of the trace which is the number of samples from the beginning (note that the first sample has an index 0).

4.2.3 Removing a Pick

To remove a pick, press the right mouse button. If the mouse pointer is near a pick, that pick will be removed. Otherwise, the most recently placed pick will be removed.

4.2.4 Look at the Time

To see if the traces shown in the zoom window are aligned, press the middle mouse button. If a time line is drawn, the traces are aligned. You can also drag the time line.

4.3 Buttons Panel

The buttons panel provide facilities to move and scale all the traces in the zoom window together. It also provide facilities like travel time display and rotation (which operates on the traces in the zoom window as a group).

Figure 15: The zoom window panel

4.3.1 Travel Time Display

SeisTool has a limited capability of displaying common phases. It is based on a travel time table package (which uses the IASPEI model). The current implementation uses the triplet mode to ensure that the traces are properly associated (see TripMode).

Figure 16 shows the analysis of a teleseismic event (from Japan) using the three components of station Arcata. The horizontal components are rotated and selected phases are displayed.

To set the depth or the delta (the epicentral angle), use the dials or enter the value directly. To change the origin time, either drag the phases using the left mouse button or enter the origin time on the *Travel Times* panel.

You also have a choice of *basic phases* and *all phases* (in the IASPEI table). You can select which phases to display by selecting and deselecting it in the phases list. ²

Unfortunately, you cannot pick phases when the travel time display is in operation. Pressing *Pick* freezes the travel time curves and allows you to pick phases.

²to expedite analysis, when a parameter is changed, phases that have been deselected will remain deselected. Initially, only P and S phases are shown.

Figure 16: Common phases display and Rotations

4.3.2 Rotations

You can also apply rotations to traces. To bring up the rotations panel (as shown in fig. 16), press the rotation button in the buttons panel. You can set the azimuth using the dial or the + and - buttons. The dial displays the orientation of the rotated axes.

Under the current implementation, the traces are rotated on display only. Unfortunately, there is no way of making the rotation permanent.

Chapter 5

Time-Series Analysis

5.1 The “Analyse” Menu

A number of time-series analysis operations are available in SeisTool under the “Analyse” menu.¹ (See fig. 17) For instance, you can remove instrument responses, filter the time series and even display a spectral plot of selected portion of the time series.

Figure 17: The “Analyse” menu

The *read instrument responses* and *read coordinates* operations are for associating

¹The grouping operations in the 1.x releases are now under the *Edit* menu and the specials are under their own menu, *Special*.

instrument responses and station coordinates with the traces using either default or specified information files. The format of such files can be found in the reference manual pages in the Appendices.

In the following sections, the use of spectral plots, filtering and other miscellaneous features are explained.

5.2 Convolution & Filtering

Operations like deconvolution assume that the traces have the correct instrument responses information. It can either come from the data file itself or associated through *read def resp* or *read resp*. *read def resp* reads in the instrument responses from a specific default file while *read resp* will prompt you for one. A *read coord* option is also available for associating station coordinates with the traces.

However, when you do *conv resp*, the default responses file will automatically be read in the absence of responses. There is no need to do *read def resp* under normal circumstances.

With correct instrument responses, SeisTool can deconvolve the time-series to ground motion or convert it to a synthetic Benioff (100kg) or Wood Anderson. A 17s-23s 10 pole Butterworth filter is also available. To convert the instrument, choose the instrument under *conv resp*. To calculate amplitudes, select *calc ampli*.² Results are outputted to the screen as well as a file with .af suffix (same name as the pick file except the pf suffix). If none of the traces is selected, the operation is carried out on all of the traces. Refer to the manual pages in the Appendices for its format.

Figure 18: Filtering

SeisTool also carries a limited collection of filters. Press *filter* to bring up the

²you don't need to choose instrument type under *Calc ampli*. The one you specified previously in *conv resp* will be used.

filters panel (see fig. 18). Currently, it has a band-pass Butterworth, lo-pass and hi-pass Butterworth filters. To filter the traces, select the filter and set the frequencies accordingly. Then select either *Filter All* or *Filter Selected* to start the filtering.

Before filtering or converting instrument, the time series is demeaned, detrended and tapered (with a 10% cosine taper).

5.3 Spectral Plots

To make a spectral plot, select the desired portion of a time-series (see the section on *Selecting a window* in the Main Window Chapter). After that, select *spectrum* from the *analyse* menu. A window as shown in the figure below should pop up.

Figure 19: Spectral plot

You have three choices of scales for the plotting: a log-log plot (which is the default), a linear-log plot or a linear-linear plot. You can also turn on or off the grid (as shown in the figure) by toggling *Grid*.

To select a different portion of the time-series, repeat the above step and then press *Redo*. To move on to the next trace, select the desired portion and press *Next*.

You can also make an ASCII dump of the spectrum by choosing *Dump*. The file will be named after the original data file with the trace number and a *.spec* appended.

When computing the spectrum, the trace portion is demeaned, detrend and tapered. You can turn this on or off using the *Options* menu.

5.4 Particle Motion

Particle Motions are trickier to operate. It uses the *Triplet Mode* mentioned in 1.3.2. Obviously, you need at least two components for each instrument to use this feature.

In the current implementation, the whole trace is used for the plot (to be precise, the overlapping portions of two components is used). You can select different combinations of the components using the Z-X, Z-Y, and X-Y buttons. If one of the components is missing, you will not get a particle motion plot.

Figure 20: Spectral plot

5.5 Frequency-Time Plots

An equally tricky feature is the frequency vs. time plot. It plots the spectrum of a specified time window against progressive time.³ The plot is in color on a color workstation while in shading on a monochrome display.

To make a plot, enter the desired length of the window (in number of samples) for taking an FFT and the interval (also in number of samples) between such windows. *Scale* is used only when *no shades* is selected from *Options*. After entering the parameters, press *Go* to begin the plotting.

Figure 21: Freq-time plot

³Caution: this is not a fully developed feature of SeisTool.

Chapter 6

Making Hardcopies

SeisTool has a limited capability in producing hardcopies. You can produce hardcopies of the waveforms in the main window only. There is no way to make hardcopies of the waveforms in the zoom window. You may, however, make screen dumps or snapshots of the zoom window with standard X windows utilities like `xwd` and `snapshot`. This chapter describes the limitations of making hardcopies with SeisTool.

6.1 Printing to Printer or File

There are two ways to get a hardcopy of the traces in SeisTool. The PostScript hardcopy can be sent either to the printer directly or to a file. Also, you can choose whether to print all the traces or just a few selected traces.

To bring up the following panel, press the *Print* button in the main window. (see fig. 22)

Figure 22: Printing Selections

Make your selections and press the *Print* button on the panel to start printing. If the environment variable `PRINTER` is set, the value is used as the default name of the printer.

The value of *traces on a page* is the maximum number of traces to be printed to a page. If the actual number of traces is less than the maximum, they will be evenly placed across the whole page. Thus, to print all the traces on one page, you can just set it to the maximum allowed value.

6.2 Layout of the Hardcopy

There is a maximum number of traces which are printed on a page. You can change it using the slider in the *Print* window. Traces are evenly spaced on a page (as in fig. 23).

Figure 23: A sample hardcopy

Along with the waveform, the length (in time) and amplitudes of each trace is also displayed. A sample is shown in the figure below.

There is no time-alignment for hardcopies. Traces are scaled individually. The picks are being printed, however.

Chapter 7

Control Settings

7.1 The Controls Panel

The controls panel (fig. 24) allows you to change various settings. The changes will take place immediately when activated. To activate, press the *activate* button. Pressing *reset* resets the panel to the current settings.

Figure 24: The controls panel

7.2 Selecting the Different Modes

Time align mode selects between time-align and absolute mode. (See the discussion on Operation Mode in 1.3 for the difference between the two modes.)

Selecting *Auto-load picks* causes the associated pick file be loaded in along with the data file. For data file in UW format, when both the original UW pick file (the 'p' file) and the SeisTool pick file (the 'pf' file) are present, the latter will be loaded in.

Selecting *decimate plotting* causes traces to be decimated when being plotted to the screen. With this mode on, the plotting should be faster.

Auto-scroll controls the scrolling of the main window when the traces in the zoom window are scrolled. (See the discussion of auto-scrolling in 4.1.2).

When a large number of traces is shown in the main window, you might not want to have the borders obscuring the view. You can turn off the borders by deselecting *show borders*.

If *UW pick style* is on, a new pick can only begin when the previous pick is named (ie. a P or S). If, however, the switch is off, picks do not have to be named. This is useful in processing teleseisms. (See 4.2.1 for the discussion of the two different styles.)

7.3 Changing the Number of Traces Displayed

The number of traces shown in either the main window or the zoom window can be changed. To do so, use the sliders in the Controls Panel. You can also enter the value directly (remember to hit the "Enter" key, however).

7.4 The "Special" Menu

A number of miscellaneous operations can be found in the *Special* menu (fig. 25).

Figure 25: The special menu

Load windows loads in an amplitude window file. The amplitude window file contain on separate lines the station name, starting and ending indices of the time window. This is a feature left from earlier versions of SeisTool.

Start triple and *End triple* can be used to enter and exit Triplet mode. Under normal circumstances, you should avoid toggling the Triplet mode manually since

several operations make assumptions about what mode it is in.

Reinit TRC is another feature passed on from earlier versions. It is used to reinit the TRC format. See the section on *Loading TRC files* (`refLoadTRC`) for loading of TRC files.

Retain config appends positioning commands to your `.seistool-init`. It saves the current position of the windows (including the main window, zoom window and buttons panel) so that they come up at the same place next time SeisTool is brought up.

Appendix A

Reference Manual Pages

af (5)	amplitude file
coord (5)	station coordinates file
elf, ff (5)	file lists
exec_script (5)	execute script
instr (5)	instrument response file
pf (5)	pick file
pick_style (5M)	picking styles in SeisTool
seistool (1)	a seismogram analysis tool
seistool-init (5)	SeisTool init file
specify_file (5M)	specifying data files in SeisTool
trc_init (5)	init file for data files in TRC format

NAME

af – amplitude file

SYNOPSIS

*[.af]

DESCRIPTION

Amplitude information is written to a .af file when "calc ampli" is selected from the "analyse" menu. See the User's Guide for how to calculate amplitudes.

Each entry in the amplitude file looks like the following:

stnnam type amplitude period index mag

where

stnnam is the station name

type is the type of instrument (NONE for deconvolution, WAS for synthetic Wood-Anderson, P? for Benioff, and L? for Butterworth)

amplitude

is the maximum amplitude

period is the associated period

index is the index where the amplitude is picked. Note that the indices start from 0.

mag is the estimated magnitude.

EXAMPLES

The following is an example of an *amplitude file*:

```
# /home/u1/andrew/data/s921461655Z
# STN_NAME TYPE AMPLI PERIOD INDEX MAG
BKSLHZ WAS 161.690 12.577 1745 1.109
BKSLHN WAS 183.880 11.416 1680 1.207
BKSLHE WAS 162.040 13.086 1742 1.093
```

WARNING

If you have applied *permanent clip* to the traces, the indices might be inconsistent with the data file. Do not use *permanent clip* if you expect to use the indices afterwards.

SEE ALSO

pf(5)

NAME

coord – station coordinates file

DESCRIPTION

The **coord** files specifies the coordinates of different stations.

Each entry in the *coord* file looks like the following:

station latitude longitude elevation comments

EXAMPLES

The following is an example of a *coord* file:

ARC	40.877	-124.075	60.0	101	BDSN Arcata
BKS	37.877	-122.235	276.0	102	BDSN Byerly
BRK	37.873	-122.260	81.0	103	BDSN Berkeley
CMB	38.035	-120.385	719.0	122	BDSN Columbia College

SEE ALSO

instr(5)

NAME

elf, flf – file lists

SYNOPSIS***[.elf]*****[.flf]****DESCRIPTION**

The two kinds of file list use for specifying events in SeisTool are **event list file** and **file list file**. The former is used to specify events that consist of a collection of data files while the latter, to specify events that are contained in single files.

You are encouraged to name your **event list files** with a .elf extension and your **file list files** with a .flf extension so that they can be distinguished easily. But of course, any file name (eg. "list") will do as well.

An **event list file** contains lines specifying the data format and the complete file name. (If the data format is not specified, it is assumed to be in the default format.) And a line containing a double colon is used to separate different events. Each line looks like the following:

[data format] file name

with the following as separators between events:

::

A **file list file**, like an **event list file**, contains lines specifying the file name and optionally, the data format. Each file is assumed to represent a different event.

Note that you can turn a **file list file** into an **event list file** just by inserting lines of "::" between each file name.

EXAMPLES

The following is an example of an **event list file**:

```
# First Event:
# an event can consist of files in different formats
UW      8803120759D
DBX     BKS_LP_/s922020754N
BIS     s922020754N.bis
# the user will be prompted for the details if a trc
# init file is not specified:
TRC     8803120759.trc
# to start a new event, use :: like the following
# if format is not specified, the default format
# is assumed.
::
# Second Event:
8803129759D
```

And the following is an example of a **file list file**:

```
8803026830D
8803129759D
SEGY    8803026830.sgy
SEGY    8803129759.sgy
```

SEE ALSO

seistool(1), **specify_file(5M)**

NAME

exec_script – execute script

SYNOPSIS

*[.exe]

DESCRIPTION

An **execute script** contains commands which specify what operations are to be performed on each of the traces being loaded in. A .exe extension is recommended for the name of an execute script but is not required.

The **execute script** contains a single command on each line. Available commands are as follow:

match resp matches instrument responses information against the station and component of the trace using the instrument file.

deconv carries out a deconvolution to ground motion.

filter [band | low | hi] low_freq high_freq
applies a filter on the trace.

EXAMPLES

The following is an example of an *execute script* which deconvolves a trace to ground motion and applies a band-pass butterworth filter (0.01-0.1 secs) to the trace:

```
deconv
filter band 0.01 0.1
```

Note that *match resp* is not necessary since *deconv* will automatically perform *match resp* when instrument information is not present in the data file.

SEE ALSO

seistool(1)

NAME

instr – instrument response file

DESCRIPTION

Instrument information is specified in the *instr* file.

Each entry in the *instr* file are lines of the following form:

```

sta chan on-date off-date azim dip units net seednam
gain numzero numpole
[ r_zero i_zero
  ... ]
[ r_pole i_pole r_pole i_pole
  ... ]

```

where

sta is the station name
chan is the channel name
on-date is the date the instrument is on-line (format of the date being *Year.Doy.HourMin*).
off-date is the date the instrument is off-line (format of the date being *Year.Doy.HourMin*).
azim is the azimuth of the instrument
dip is the dip of the instrument
units is the units of the measurements. (eg. (DU/MS-2) for acceleration, (DU/MS-1) for velocity and (DU/M) for displacement)
net is the name of the network
seednam is the SEED channel name
gain is the gain factor
numzero is the number of zeros
numpole is the number of poles
r_zero, i_zero, r_pole, i_pole
 are the zeros and poles (in complex numbers, *r*'s being the real parts and *i*'s being the imaginary parts). Note that there is one zero on each line but two poles on each line (except maybe the last line of poles).

EXAMPLES

The following is an example of an *instr* file:

```

ARC ZVSP 1992.147.2200 2599.366.2359 0.00 -90.00 (DU/MS-1) BDSN HHZ
  3.06895E+16 2 5
  0.000000E+00 0.000000E+00
  0.000000E+00 0.000000E+00
  -3.702367E-02 3.702438E-02 -3.702367E-02 -3.702438E-02
  -1.186336E+02 4.230651E+02 -1.186336E+02 -4.230651E+02
  -2.513274E+02 0.000000E+00
ARC NVSP 1992.147.2200 2599.366.2359 0.00 0.00 (DU/MS-1) BDSN HHN
  2.96533E+16 2 5
  0.000000E+00 0.000000E+00
  0.000000E+00 0.000000E+00
  -3.702367E-02 3.702438E-02 -3.702367E-02 -3.702438E-02
  -1.186336E+02 4.230651E+02 -1.186336E+02 -4.230651E+02
  -2.513274E+02 0.000000E+00

```

INSTR(5)

FILE FORMATS

INSTR(5)

SEE ALSO
coord(5)

NAME

pf – pick file

SYNOPSIS

*[.pf]

DESCRIPTION

The pick file contains information about picks of an event (which can be a single data file or a bunch of data files). All the pick files written by SeisTool have the *pf* suffix. (Pick files for UW data files are named with "pf" suffices while the rest, ".pf".)

Each pick is listed on a different line. But picks on the same trace are guaranteed to be listed consecutively. The first character of each line acts as a label:

space	denotes a pick (note this is <i>required</i>)
P	denotes complication (see below)
T	specifies the earliest first sample time

When the pick file is read in, only the sample index is significant. (In other words, neither the pick time nor the seconds offset will be looked at.) Also, the 'T' line is optional.

There is one more complication, however. The pick file formats at LBL and at UCB Seismo station differ slightly. The one at the station has one more "column" of channel names. The station's pick files are marked with the following as the first line:

Pickfile V.2

Each entry in the pick file looks like the following:

sp stnnam idx qual name secs fmotion unc utctime

or the following for the version 2 pick file:

sp stnnam chn idx qual name secs fmotion unc utctime

where

sp is a space denoting a pick information line

stnnam is the station name

chn is the channel name (in Pickfile V.2)

idx is the index (in the trace data) of the sample picked. (Note that SeisTool keeps track of the picks internally by the sample index and hence a pick can only land exactly on a sample.) Note also that the indices start from 0.

qual indicates the quality of the pick (i for impulsive and e for emergent)

name is the phase name of the pick.

secs is the difference between the pick time and the earliest first sample time (among the traces).

fmotion indicates first motion (U for up and D for down)

unc is the uncertainty. Currently, it is estimated by the degree of zooming of the trace. (NB: This is more like a place holder at this point.)

utctime is the actual (UTC) time of the pick.

FORMAT

In C, each of the entries can be read in with the following format string for the original version:

"%s %d %c %s %f %c %f"

and the following for the second version:

"%s %s %d %c %s %f %c %f"

EXAMPLES

The following is an example of a *pick file* (the original version):

```
T 90 295 20:59:50.981600
1v  2955 ? P  6.1562 D 0.0000 1990 295 20:59:57.137850
1l  2955 ? P  6.1562 ? 0.0030 1990 295 20:59:57.137850
1l  3065 ? S  6.3854 U 0.0000 1990 295 20:59:57.367016
2v  2969 ? P  6.1854 D 0.0000 1990 295 20:59:57.167017
5v  2975 ? P  6.1979 U 0.0000 1990 295 20:59:57.179516
```

And the following is an example of the second version of the *pick file* (ie. the one used at the station):

```
Pickfile V.2
T 90 295 20:59:50.981600
BKS BHZ  2955 ? P  6.1562 D 0.0000 1990 295 20:59:57.137850
BKS BHN  2955 ? P  6.1562 ? 0.0030 1990 295 20:59:57.137850
BKS BHE  3065 ? S  6.3854 U 0.0000 1990 295 20:59:57.367016
STAN BHZ  2969 ? P  6.1854 D 0.0000 1990 295 20:59:57.167017
```

WARNING

A common pitfall in switching between the UofW pick style and the SeisTool pick style is getting a "pu" for phase name but "?" for first motion instead of "P" for phase name and "U" for first motion. Consult the manual for how to name a pick with the pick style you are using.

If you have applied *permanent clip* to the traces, the indices might be inconsistent with the data file. Do not use *permanent clip* if a pick file is to be written.

SEE ALSO

af(5), **pick_style(5M)**

NAME

pick_style – picking styles in SeisTool

DESCRIPTION

There are two styles of picking (ie. mouse and keyboard actions for picking) in SeisTool. One of them, the so-called **UW pick style**, closely resembles the University of Washington software *xped*. The other one is SeisTool's default pick style, named the **ST pick style**.

Do not confuse this with the pick file format. SeisTool uses the same pick file format no matter which pick style you choose.

The differences between the two styles are highlighted below:

- + in UW pick style, a pick has to be named (either P or S) before another pick can be placed
- + in ST pick style, a pick can be named with a phase name of at most 8 characters. Also, you do not need to name a pick before placing another one.
- + in ST pick style, the picks can be dragged.

The keyboard actions of ST pick style are as follows.

- + (or =) first motion up
- first motion down
- \ first motion unknown
- e (or E) emergent
- i (or I) impulsive
- backsp delete one character from the phase name
- others taken to be part of the phase name

Note that you do not need to press *i* or *e* before entering the phase name.

And the keyboard actions of UW pick style are as follows.

- u first motion up
- d first motion down
- n first motion unknown
- e (or E) emergent
- i (or I) impulsive
- p P phase
- s S phase

LIMITATIONS/BUGS

You cannot delete an emergent/impulsive annotation once given. You need to remove the pick and place a new pick.

Since the 'i' is used for denoting impulsive, you will not be able to name a phase like "PKiKP". A work-around is to change the pick file directly.

SEE ALSO

pf(5)

Yu, Andrew K., *SeisTool Ver 2.1 User's Guide*, June 5, 1993.

NAME

seistool – a seismogram analysis tool

SYNOPSIS

seistool [*options*] [*filename...*]

DESCRIPTION

seistool is an interactive, menu-driven tool that allows users to look at seismograms. It runs under X version 11 release 4 or above and assumes a three-button mouse. It can display a bunch of seismograms and has a zoom window for zooming in on a few traces at the same time. It also allows phase picking within the zoom window.

seistool handles a repertoire of local, frequently used formats. It currently takes data files in UW format, DBX format, TRC format, BIS format, SDR format, SEG-Y format or SAC format.

seistool handles traces file that has different start times and different total number of samples. (the *-align* switch allows traces to align in absolute time.)

seistool also has a number of built-in time-series and spectral analysis operations such as rotations, filtering, instrument deconvolution, frequency-time plots and particle motion plots. It also has a display of travel time curves.

USAGE

seistool can be invoked without any argument. If files are specified, however, **seistool** will load them in when it starts up. The current default format is SEG-Y (at LBL) or SDR (at Seismo Station, UCB).

OPTIONS

In addition to the standard X settings like *-bg color* or *-fg color*, the following can also be used:

-align enables time alignment. All the traces will be scaled and aligned in absolute time when being loaded in. (This is the default.)

-el event_list_file

takes in an event list file which specifies events comprising a collection of files. (This is equivalent to doing a *Load Event* in the files menu).

-exec exec_script

sets specified file as the execute script. It is sourced whenever traces are loaded in. (This is equivalent to doing a *Set Exec* in the files menu.)

-fl file_list_file

takes in a file list file which specifies events in single files. (It is not possible to do this within SeisTool yet.)

-format [UW | BIS | DBX | TRC | SDR | SEG-Y | SGY | SAC]

sets the default format. The files specified in the command-line arguments will be assumed to be in such format.

-help a brief summary of command line options.

-noalign

disables time alignment.

-noborder

disables borders in the main traces window.

-numtr value

sets number of traces in the main traces window. Note that the number of traces cannot be greater than the initial maximum value.

-numztr value

sets number of traces in the zoom window.

-sele select_file

reads in selection expressions from the specified file and select traces with matching names

accordingly.

-trcini *trc_init_file*

sets the defaults for a TRC file (such as station list file, sampling rate, etc.) This is only useful for files in TRC format.

EXAMPLES

% seistool

starts up seistool with no arguments. Files can be specified later on with the buttons and menus.

% seistool -format UW 880603103046p 910223075959p 9206270447p

starts up seistool with a bunch of data files in University of Washington format. (Note that you can specify any one of the 'D', 'd' or

% seistool -align -format TRC -trcini trc.ini 910222083313.trc

starts up seistool with a TRC file (sampling rate and station names are specified in the "trc.ini" file); the *-align* causes the traces to be scaled properly when individual traces has different number of samples.

% seistool -el list.elf

starts up seistool with an event list file specifying the format and file names of the data files.

ENVIRONMENT

the following variables should be set properly for some of the options to work:

HOME home directory path

PRINTER the printer to send hardcopy to

FILES

\${SEISTOOLHOME}/src/release.motd
for the start-up message

./seistool-init or ~/.seistool-init
for the init file

SEE ALSO

seistool-init(5), specify_file(5M)

Yu, Andrew K., *SeisTool Ver 2.1 User's Guide*, June 5, 1993.

BUGS

Bug sightings can be reported to andrew@geo.lbl.gov.

NAME

seistool-init – SeisTool init file

SYNOPSIS

./seistool-init

~/seistool-init

DESCRIPTION

The *seistool-init* file contains various default settings. When SeisTool starts up, it looks for this init file. The current directory is searched first and if the init file is not found, the home directory is then searched.

The file should contain on single lines one or more of the following. (A line starting with a # is treated as comments and will be ignored.)

set align [*on* | *off*]

turns time-alignment mode on or off. If time-alignment mode is on, traces are aligned in absolute time. Otherwise, traces are not aligned. (The default is on.) You will only get a time scale in the main window with this mode on.

set autodemmean [*on* | *off*]

turns on or off the automatic demeaning of traces when they are loaded in. (The default is on.)

set alt_instr_file *filename*

sets an alternate instrument response file. This file will be searched for instrument responses after the regular instrument response file is searched.

set border [*on* | *off*]

turns borders in the main window on or off. If you have tens of traces in the main window, you might want to turn this off. (The default is on.)

set coord *filename*

sets the station coordinates file.

set decimplot [*on* | *off*]

if decimplot is on, the traces are decimated when displayed on the screen. Otherwise, the whole traces are plotted. (It will be slower with this mode turned off; default is off.)

set format [*DBX* | *UW* | *TRC* | *BIS* | *SDR* | *SEGY* | *SGY* | *SAC*]

sets the default format. See the User's Guide for an explanation of the different formats. (The default is SEG Y at LBL and SDR at the UCB Seismographic station.)

set groupcomp [*on* | *off*]

group the traces in bunches of verticals and horizontals when they are loaded in. (Note: don't set regroup together with groupcomp)

set instr *filename*

sets the instrument response file.

set numtr *value*

sets the number of traces displayed in the main window.

set numztr *value*

sets the number of traces displayed in the zoom window.

set regroup [*on* | *off*]

reorder successive traces with same name except component in Z, N, E order. (Note: don't set groupcomp together with regroup)

set timescale [*on* | *off*]

if timescale is on, a time scale is displayed in the zoom window. (Only valid when SeisTool is in time alignment mode.)

set trcinit *filename*
sets the init file for TRC data files.

set uwpickstyle [*on* | *off*]
turns UofW pick style on or off. This affects mouse actions for picking only and does not affect the pick file format. The UofW pick style emulates the picking method in the UofW software, *xped*. (The default is off.)

position main[_window] *x y*
makes the main window come up at (x,y) position on the screen

position zpan[el] *x y*
makes the buttons panel come up at (x,y) position on the screen

position zwin[dow] *x y*
makes the zoom window come up at (x,y) position on the screen

size main[_window] *width height*
makes the main window come up at the specified size

size zpan[el] *width height*
makes the buttons panel come up at the specified size

size zwin[dow] *width height*
makes the zoom window come up at the specified size

SEE ALSO**seistool(1)**

NAME

specify_file – specifying data files in SeisTool

SYNOPSIS

seistool [*filename ...*]

seistool -el *event_list_file*

seistool -fl *file_list_file*

seistool { [*filename ...*] }

DESCRIPTION

The simplest way to load data files into SeisTool is to use the graphical interface. Just bring up SeisTool and use the "Files" Menu. "Load file" items load in a single file at a time while "Load event" loads in an event list file.

However, to expedite the loading, you can utilize the command line options. First of all, the default format can be changed by the *-format* option. (See *seistool(1)* for details.) The different ways of grouping files into events are described below.

The following treats each file as a single event (eg. files in UW, SEG-Y, or TRC format).

```
% seistool file1 file2 file3 ...
```

You can also use a *file list file* to do the above. For example, with a *file list file* like the following, a "seistool -fl list.ff" loads in the files just like the example above.

```
file1
file2
file3
```

The following treats the collection of files (specified between the braces) as a single event. (eg. files in DBX, BIS, SDR or SAC format)

```
% seistool { file1 file2 file3 ... }
```

You can also use an *event list file* (eg. list.elf) to do the above: (refer to *elf(5)* for its format)

```
% seistool -el list
```

Note that a combination of the above will work as well. The following loads in four different events:

```
% seistool file1 file2 { file3 file4 } -el list
```

SEE ALSO

seistool(1), *elf(5)*, *flf(5)*

NAME

`trc_init` – init file for data files in TRC format

DESCRIPTION

The `trc_init` file supplements information a TRC data file lacks. Once initialized, it is used for other TRC files as well.

A `trc_init` file contains one or more of the following lines in any order (note that a line starting with a # denotes comment):

`statlist` *station list file*

sets an associated station file (which contains station names on separate lines in the same order as the traces in the data file).

`datatype` [*short* | *int* | *float*]

specifies what the type of data the TRC file contains (*short* for 2 bytes integers, *int* for 4 bytes integers and *float* for 4 bytes real).

`srate` *sampling_rate*

specifies the sampling rate (in samples per second) of the traces.

EXAMPLES

The following is an example of a `trc_init` file:

```
datatype short
srate 500
statlist /m/home/u/andrew/seistool/data/itrc_statlist
```

Appendix B

Quick Reference

Main Window

- selects where to zoom in on (when zoom window is up)
- - clips traces to the right
- - clips traces to the left
- CTRL** - (DRAG) selects a time window on a trace
- CTRL** - brings up the time window panel
- CTRL** - deselects a time window
- zoom on selected time window (if one is selected)
- restores to full scale (no clipping)

Main Window Label Box

- marks a trace selected/deselected
- brings up the information window
- CTRL** - shows number of samples, sampling rate and trace index

Zoom Window

- places a pick
- (DRAG) drags a pick (when pointed at one)
- removes a pick
- puts up a "time line"
- - **SPACE** places a pick (while "time line" up)
- or first motion up
- first motion down
- first motion unknown
- or emergent
- or impulsive
- a-z, A-Z, 0-9** other characters go to the phase name (eg. P, pP, S, etc.)
- removes a character from the phase name

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END