A User's Manual

To

TIMCPOT: Tcl/Tk Interface for Measuring Crustal Phase Onset Time

Version R1.0

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Contents

File list

./bin/

./example/data/20110620.171.10.16.49.000_5.3
./example/data/20110809.221.11.50.17.000_5.2
./example/station.loc.txt

./src/evtlocate.f90
./src/fftsub.f90
./src/hilbertsac.f90
./src/libsun.f
./src/libtau.f
./src/makefile
./src/sacio.a
./src/timcpot.tcl
./src/timesub.f90
./src/ttlim.inc

./sup.soft/ttimes.tar.gz

./manual.pdf

Installation

TIMCPOT runs on Linux OS. At present, we have tested it in the following Linux OS:
Red Hat Enterprise Linux Server 6.4
Red Hat Enterprise Linux Server 6.10
Red Hat Enterprise Linux Server 7.6
CentOS 6.6
We didn't conduct more tests on other platforms, but it doesn't mean that TIMCPOT does not work on other platforms. If you have applied it on a platform successfully rather than those as listed above, please let us know, we appreciate your feedbacks.

Requirements of OS platform
OS: Linux
Disk space: <100Mb
CPU: 2.0GHz
RAM: >2GB
Screen: 1920 x 1080

TIMCPOT depends on SAC, ttimes and Tcl/Tk packages. These packages should be installed before running TIMCPOT.

Install SAC

We recommend to build SAC from source code. More details on how to install SAC, please refer to the following websites:
http://www.iris.edu/software/manual.html
https://seisman.github.io/SAC_Docs_zh/install/linux-source/

Install ttimes

A modified version of *ttimes* package can be found in sup.soft folder, named ttimes.tar.gz.
Unzip this package to a directory (e.g., ~/prog/ttimes).
Add the following line to ~/.bashrc or ~/.bash_profile
export HOMETTIMES=~/prog/ttimes
The environment variable, HOMETTIMES, should be correct. It is not only required by ttimes/ttimes.f, but also required by src/evtlocate.f90.
Next, open a terminal and follow the commands to finish installation.

```
source ~/.bash_profile    or    source ~/.bashrc
cd ~/prog/ttimes
make
./remodl iasp91
./setbrn
./remodl ak135
./setbrn
cp ttimes ~/bin/
```

Install Tcl/Tk

TIMCPOT depends on latest release version of Tcl/Tk packages, named tcl8.6.12-src.tar.gz and tk8.6.12-src.tar.gz. User can download them from https://tcl.tk/software/tcltk/download.html.
Additionally, a copy of Tcl/Tk packages can be found in sup.soft folder. Note, if user obtain TIMCPOT package through supplemental material, user would not find Tcl/Tk packages in sup.soft folder due to a limitation of maximal file size.
tcl8.6.12-src.tar.gz and tk8.6.12-src.tar.gz should be unzipped into an identical folder. Otherwise, user may need to tell Tk where Tcl was built with the *--with-tcl* flag when user configure Tk. See more details at https://tcl.tk/doc/howto/compile.html.
Here is a brief introduction for how to compile Tcl/Tk from source distribution in my Linux platform, and user can take it as a reference.
Unzip Tcl/Tk packages into ~/prog/, and then the directory structures should be listed as:
~/prog/tcl8.6.12
~/prog/tk8.6.12

Next, open a terminal and follow the commands to finish installation.
For Tcl:

```
cd ~/prog/tcl8.6.12/unix
./configure --prefix=/home/xxx/prog/tcl8.6.12
make
make install
```

Note: characters 'xxx' should be replaced by which are actually shown in user's computer.

For Tk:

```
cd ~/prog/tk8.6.12/unix
./configure --prefix=/home/xxx/prog/tk8.6.12
make
make install
```

Note: characters 'xxx' should be replaced by which are actually shown in user's computer.

Add the following two lines to ~/.bashrc or ~/.bash_profile

```
export PATH=~/prog/tcl8.6.12/bin:$PATH
export PATH=~/prog/tk8.6.12/bin:$PATH
```

Install TIMCPOT

Copy TIMCPOT package to a folder (e.g., ~/prog/)
copy sacio.a from SACHOME/lib/ to TIMCPOT/src.
Next, open a terminal and follow the commands to finish installation.

```
cd ~/prog/TIMCPOT/src
make
```

Add the following line to ~/.bashrc or ~/.bash_profile

```
export PATH=~/prog/TIMCPOT/bin:$PATH
```

Demonstration

An example is used to check whether or not all the requirements are available or workable. In order to obey rules of data usage, station's coordinate stored in example data folder has been rounded to one decimal place. Furthermore, data sample is decimated to an interval of 0.1s. So, this data is only used for test.

After installation, follow the next commands to check if it is workable.

```
source ~/.bash_profile    or    source ~/.bashrc
cd ~/prog/TIMCPOT/example
mkdir outdir
timcpot.tcl data/ outdir/ station.loc.txt
```

A graphical interface will show on user's computer screen. Once user finishes the following operations (Step1 -Step6) and if user obtains an appearance similar to Figure 1, it would indicate that all of the requirements are available and workable.

Step1: click at one of the event ID lists

Step2-Step4: click Load button

Step5: press left mouse button and drag

Step6: check all of three checkboxes

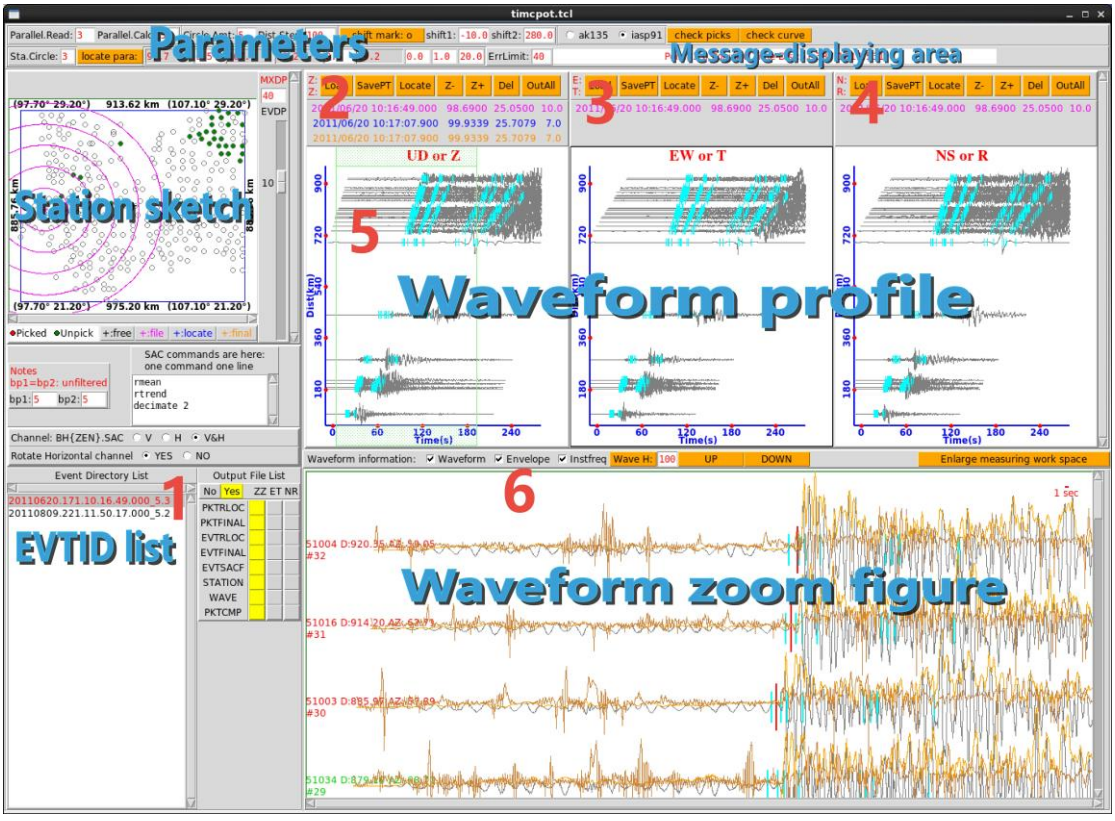


Figure 1. Screenshot of TIMCPOT and explanatory notes

Data preparation

The data format and necessary parameters

TIMCPOT only supports one type of seismic data format at present. It is SAC format, widely used in seismological community. Several kinds of necessary parameters for both events and stations are saved as variables in data header of SAC file.

The following header variables should be assigned with a correct value.

Station information: *stla*, *stlo*, *stel*, *kstnm*

Event information: *evla*, *evlo*, *evdp*, *o*, *mag*

Channel information: *cmpaz*, *cmpinc*

Data information: *delta*, *kzdate*, *kztime*

Note: User can refer SAC manual file for more details of these header variables. The unit for station and event coordinate is degree and the unit for station elevation and event depth is kilometer. The data samples of all SAC files should be unified into an identical interval. All reference times of SAC files corresponding to an identical event should be unified to an identical reference date and time. For an identical event, if *delta*, *kzdate* and *kztime* are assigned with inconsistent values, it will result in unforeseeable mistakes.

Directory structure and filename format

The SAC files are sorted by event. Events should be identified with IDs, name EVTID. Station should also be distinguished by IDs, usually taking station name (*kstnm*) as STAID. The directory structure is organize as a pattern as "data/EVTID/EVTID.STAID.BH?.SAC". EVTID is used as a folder name, the combination, EVTID.STAID.BH?.SAC, is used as filenames of SAC files. An example shown in demonstration is "data/20110620.171.10.16.49.000_5.3/20110620.171.10.16.49.000_5.3.51002.BHZ.SAC".

(1) "20110620.171.10.16.49.000_5.3" is EVTID. EVTID consists of a time point and event magnitude. e.g., this event occurred on 20 June, 2011, at 10:16:49.000, with magnitude of 5.3. 171 is Julian day.

(2) "51002" is STAID, and is equal to *kstnm*, a header variable stored in SAC file. This part must be also equal to station name that was stored in example/station.loc.txt. Note: STAID field cannot include dot ".", otherwise, unforeseeable mistakes will be introduced.

(3) "BHZ.SAC" contains information on seismic data channel and data format. This part is limited to "BHZ.SAC", "BHE.SAC" or "BHN.SAC".

Generally, EVTID is not fixed, user can define their preferred format for EVTID. STAID must be equal to station name, and this field is limited to no more than 8 characters, as well, dot "." is forbidden. The third part is fixed to 7 characters, and should be one of "BHZ.SAC", "BHE.SAC" and "BHN.SAC". For more details about directory structure, user can refer to what are stored in example/data.

Station information

User should prepare station information according to what is stored in example/station.loc.txt. There are four columns separated by blank space(s). The text format is not fixed, but station information must be listed in an order as name, latitude, longitude and elevation.

Procedure and brief introduction

In a terminal command window, change directory to TIMCPOT/example, create a folder with name outdir, input commands

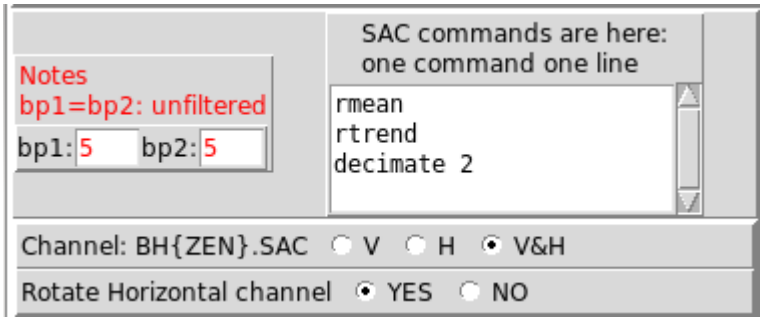
```
source ~/.bash_profile    or    source ~/.bashrc
cd ~/prog/TIMCPOT/example
mkdir outdir
timcpot.tcl data/ outdir/ station.loc.txt
```

A graphical interface will display as Figure 1. The top two lines are for several groups of parameters. Details for these parameters will be explained in the subsequent procedures. Please remember there is a uniform regulation: if a parameter values with red font is modified in any textbox with white background, user should click right mouse button to make it available throughout TIMCPOT. Meanwhile, a message is shown in message-displaying area.

Once the graphical interface is shown, a list for event ID will be loaded into TIMCPOT, as what is shown in the left bottom corner of TIMCPOT. A sketch for station position is also shown in the left top corner.

Parameters for preprocessing

Before processing seismic data, user can set up some parameters for preprocessing.



Bandpass filter parameters are set at bp1 and bp2. If bp1 is equal to bp2, seismic data will be unfiltered. Otherwise, data will be filtered by the aid of SAC package following a command as "*bp co bp1 bp2 p 2*". Other SAC commands are also available. User can type SAC commands in the textbox. It should be one command one line.

Sometimes, user just needs to deal with vertical/horizontal channels. To save computation time, three radio buttons are combined as one group to fulfil this demand. V: vertical; H: horizontal; V&H: vertical and horizontal. In addition, user can choose whether or not to rotate horizontal channels via another group of radio buttons.

Processing data

Once user clicks on any event ID, TIMCPOT will follow preprocessing parameters to handle seismic data. Finally, the prepared data will be saved in a temporary folder, named swap. During this procedure, TIMCPOT will run in parallel mode. The amount of thread used in parallel mode is set at Paralle.Read and Parallel.Calc. Where, the first value is for the amount

of thread used to read SAC file; the second value is for the amount of the thread used to preprocess seismic data. Due to the I/O restrictions of hard disk, the amount of thread for reading cannot be greater than those for preprocessing.

Displaying station and event information in sketch

After clicking Load button, the sketch for station (Figure 2) is updated. Station positions are marked as circles, and those stations with waveform records are filled with green/red color. The circle size can be changed by modifying the value beside Sta.Circle. The big concentric circles denote epicentral distance. The amount of concentric circles and interval between two adjacent circles are given in the values beside Circle.Amt and Dist.Step.

The event position is marked as a cross '**+**' in station sketch. As you could see, the amount of cross is more than one and these crosses are distinguished by different colors. The black one is manually free, user can move it to a desired position by clicking left mouse button. The magenta one denotes the event location stored in SAC file. The blue one marks location of event derived from relocation procedure. The yellow one represents the final location exported by TIMCPOT. Note, the relocation procedure embedded in TIMCPOT can inverse event location using two algorithms. That means, after relocation procedure, two positions (two crosses) will be obtained for the event. So, the amount of cross is five at most.

Not all of the crosses are always visible. Firstly, event positions from different sources are consistent with each other. e.g., it is even possible that relocation procedure could result in a position as that stored in SAC file. It means that the crosses may overlap at an identical position. Secondly, user should take attentions, the relocation positions (two blue crosses) are not available/visible before conducting relocation procedure. And it is the same case for the final location (yellow cross) before clicking OutAll button. Moreover, event positions may be placed out of the visible regional range of station sketch. User can check whether or not event positions are available in a gray-shaded board on top of the waveform profile (Figure 3). The font color in this board is the same as those for crosses in station sketch.

A scale to the right of station sketch is used to show event depth corresponding to the event that is marked with big concentric circles. The color of concentric circles is also the same as those for crosses in station sketch. Actions and its corresponding operations in station sketch are listed in Table 1.

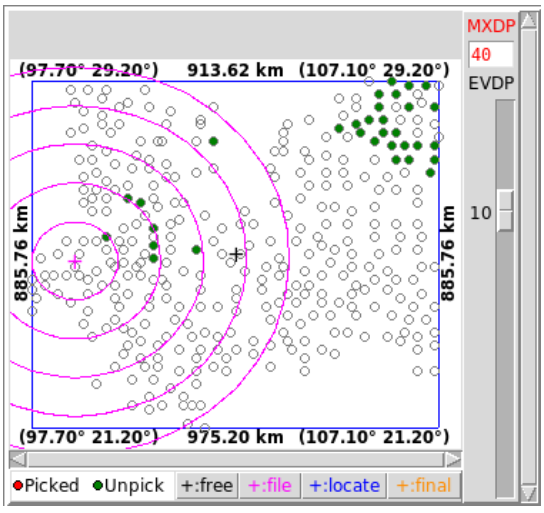


Figure 2. Station sketch

Table 1. Actions and operations in station sketch

Actions	Operations
Click left mouse button	Move black cross to mouse cursor position
Press left mouse button & drag	Move station sketch
Scroll mouse wheel	Zoom in/out station sketch
Click right mouse button	Turn on measuring distance
Double-click right mouse button	Turn off measuring distance
Click right mouse button on event cross	Move concentric circles to current event cross; Update waveform profile
Press key-x	Disable/enable green lines following mouse cursor
Click middle mouse button on stations	Select/deselect a station to inspect its waveform (if available)
Click middle mouse button on concentric circles	Delete concentric circles

Displaying seismic data in waveform profile

After clicking Load button, waveforms are loaded as what is shown in Figure 3. In this profile, waveforms are sorted by epicentral distance and are aligned with a specific time marker. The time marker is chosen from button shift mark: o, the nearby two values, shift1 and shift2, are used to determine the length of waveform time widow. Waveforms are shown as dark-gray curves. Manual picks are shown as red ticks if those are available. Theoretical predictions are shown as cyan ticks. Theoretical predictions are derived from 1D velocity model through *ttimes* package. Optional velocity model includes ak135 and iasp91, which can be switched through a group of radio buttons ⊙ak135 ⊙iasp91.

On the top of waveform profile panel, there are a gray-shaded board and a row of buttons. The board is used to shown event information as mentioned above. The functions of these buttons are listed in Table 2. The actions and its corresponding operations in waveform profile are listed in Table 3.

Table 2. Functions of buttons

Button	Function
Load	Load seismic data; Update station sketch; Create waveform profile
SavePT	Save manual picks to output folder as a file with file extension as PICK.FORLOC This file contains manually picking traveltime for relocation procedure
Locate	Save manual picks; Relocate hypocentral position; Output relocation results to output folder as a file with file extension as EVENT.RLOC
Z-	Scale down waveform amplitude
Z+	Scale up waveform amplitude
Del	Delete all of the output files corresponding to the selected event ID
OutAll	Output results, including: PKTFINAL: manual picks, complete information for tomographic study EVTFINAL: the optimal solution for event location EVTSACF: event location stored in SAC file STATION: station sketch figure WAVE: waveform profile figure PKTCMP: comparison chart for manual picks

Table 3. Actions and operations in waveform profile

Actions	Operations
Double-click left mouse button	Shown manual picks as ticks or curve
Press left mouse button & drag	Select a time window, and then show its details in waveform zoom figure (Figure 4)
Click middle mouse button	Turn on/off theoretical predictions
Click middle mouse button on waveform curve	Select/deselect a waveform and inspect its auxiliary information
Click right mouse button	Move the waveform zoom figure to the nearest epicentral distance.
Move mouse cursor on prediction tick	Show phase name of prediction
Press key-x	Set up beginning/endding of the time window showing in waveform zoom figure (same as press left mouse button & drag). Note, It is not workable if time window is < 10 screen units.
Press key-space	Show/hide waveform

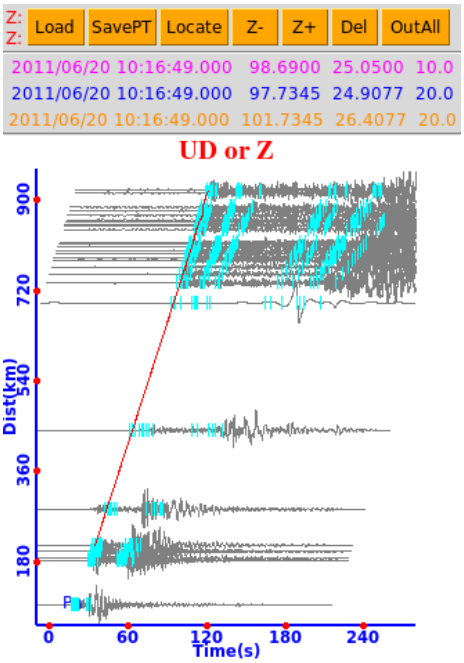


Figure 3. Waveform profile

Picking phase onset time

By pressing and dragging left mouse button in waveform profile, user can select a time window and inspect details of waveform in a zoom figure (Figure 4). Select/deselect checkboxes, ☐waveform ☐Envelope ☐Instfreq, seismic waveform, envelope and instantaneous frequency will be shown/hidden, respectively. All of these kinds of curves are shown after normalization. The normalized height is set at Wave H: 100. Three values are embedded in button Wave H:. User is allowed to apply their preferred normalized height, which can be achieved by modifying the value in textbox adjacent to Wave H:. Please don't forget to click right mouse button on this textbox, in order to make it to be available throughout TIMCPOT. Two buttons, UP and DOWN, are used to scale up and scale

down waveform amplitude, respectively.

User can enlarge work space by clicking Enlarge measuring work space button, or return back by clicking Shrink measuring work space button. A brief information (station ID, distance, azimuth and number) is marked as a label to the left side of each waveform. A time scale is plotted in top right corner of Figure 4. User can measure phase onset time through several actions as listed in Table 4.

Table 4. Actions and operations in waveform zoom figure

Actions	Operations
Press left mouse button & drag	Zoom in waveform
Click right mouse button	Zoom out waveform
Double-click left mouse button	Mark a time tick on mouse cursor position
Press left mouse button & drag on time tick	Move time tick
Click middle mouse button on time tick	Delete time tick
Click middle mouse button	Turn on/off theoretical predictions
Click middle mouse button on waveform	Select/deselect a waveform and inspect its auxiliary information
Click middle mouse button on station name label	Select/deselect a waveform and inspect its auxiliary information
Move mouse cursor on prediction tick	Show phase name of prediction
Press key-x	Disable/enable green lines following mouse cursor
Press key-space	Re-normalize waveform amplitude in current view. See example in Figure 5

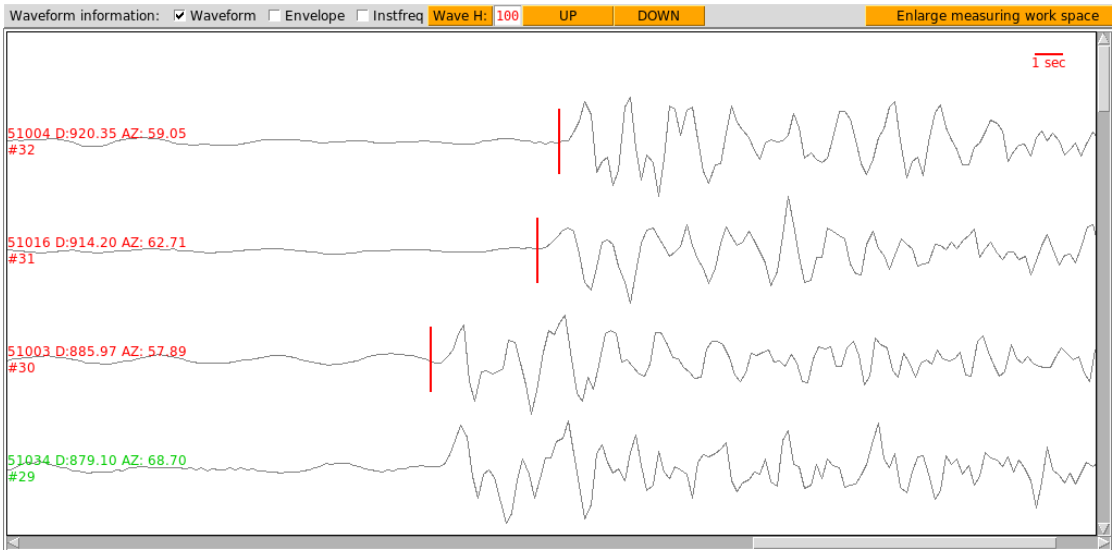


Figure 4. Waveform zoom figure

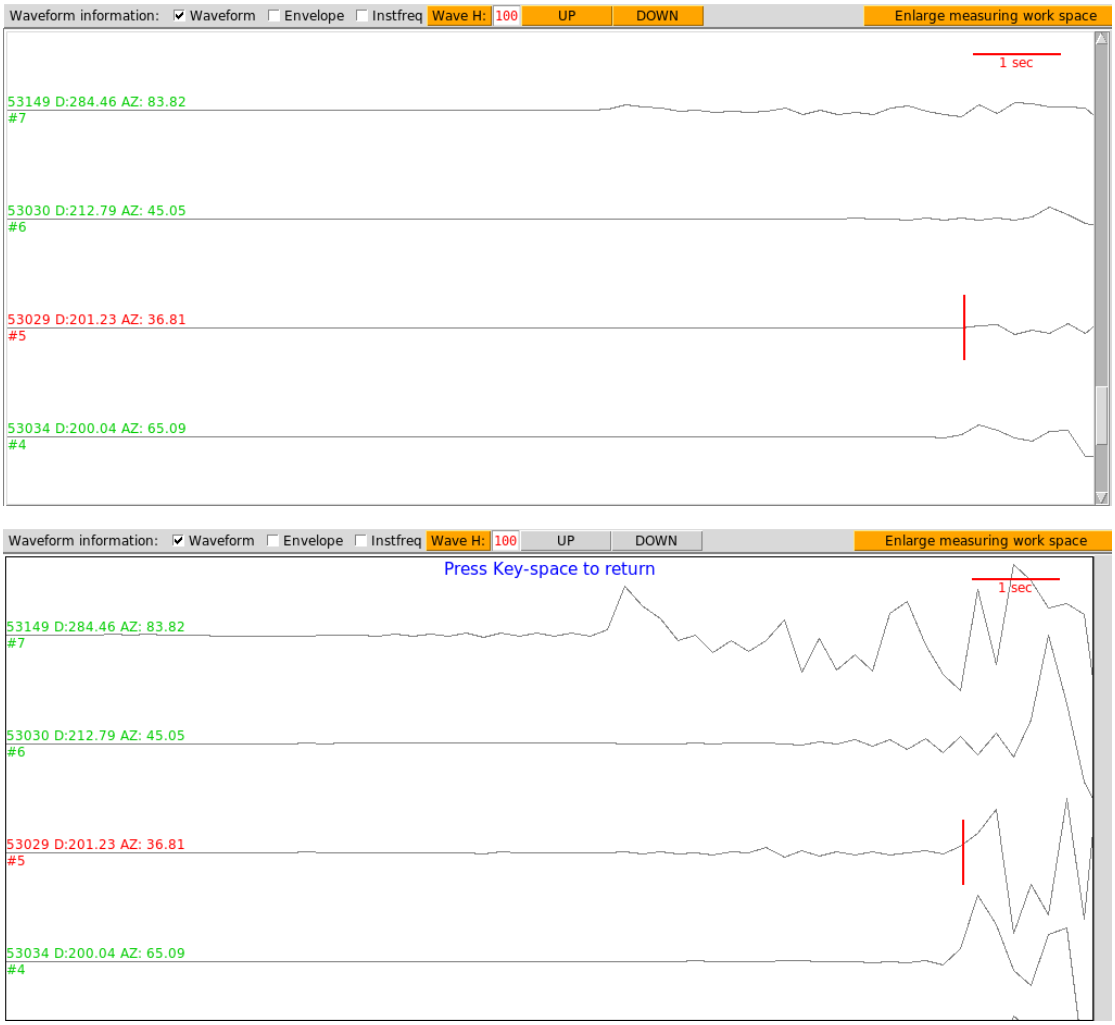


Figure 5. Example to show function of pressing key-space

Top panel: waveform before pressing key-space; bottom panel: waveform after pressing key-space. The obvious difference is that waveform amplitude was re-normalized.

Relocating hypocentral position

User can relocate hypocentral position by clicking Locate button. Hypocentral position is solved out through a grid-based search algorithm. Several groups of input arguments should be provided to this processing.

The first group of parameters is regional range in which the relocation procedure will search for hypocentral position. This group of input arguments is given in the format as following:

lonmin	*lonstep*	*lonmax*	*latmin*	*latstep*	*latmax*	*depmin*	*depstep*	*depmax*

Regional boundary: *lonmin, lonmax, latmin, latmax, depmin, depmax*

Grid interval: *lonstep, latstep, depstep*

Gray-shaded arguments (*lonmin, lonmax, latmin* and *latmax*) are automatically set by loading values from station sketch boundary (Figure 2). White-shaded arguments (*lonstep, latstep, depmin, depstep* and *depmax*) are manually set by user. By clicking Locate para: button, user can enter interval value quickly through several combinations of grid intervals.

The second group of parameters is velocity model. Optional velocity model includes ak135 and iasp91, which can be switched by a group of radio buttons ⊙ak135 ⊙iasp91.

The third group of parameters is manual picks and error limitation. Manual picks are transmitted to relocation procedure through a file that is stored in output folder with file extension as PICK.FORLOC. Error limitation is a value defining the maximal deviation used by relocation procedure. The larger this value is, the more picks would be used to relocate hypocentral position. Error limitation is set at ErrLimit.

After relocation procedure, waveform profile will be automatically updated and two blue crosses (+) will appear in station sketch figure. Sometimes, these two blue crosses would overlap.

Checking manual picks

TIMCPOT provides two ways to evaluate manual picks preliminarily. One way is to check difference between picks which are currently being measured and which were previously identified. The other is to check the smoothness of traveltime curve. Two windows (Figure 6) will pop up for these two checking procedures as user clicks buttons check picks and check curve, respectively.

Both figures will be updated immediately once user marks or deletes a time tick. The magenta circles are for those picks of event which is currently being measured. The black dots are for those picks which were identified previously. Middle mouse button is bound with magenta circles to inspect more information on manual picks. In right figure, red line segments and red dots compose a sketch for traveltime curve. Details of traveltime curve sketch can be inspected through mouse wheel and button. Table 5 lists available actions and its operations.

Table 5. Actions and operations

Actions	Operations
Click middle mouse button on magenta circle. (Left figure)	Select/deselect its waveform and inspect its auxiliary information
Scroll mouse wheel (Right figure)	Zoom in/out traveltime curve
Press left mouse button & drag (Right figure)	Move traveltime curve

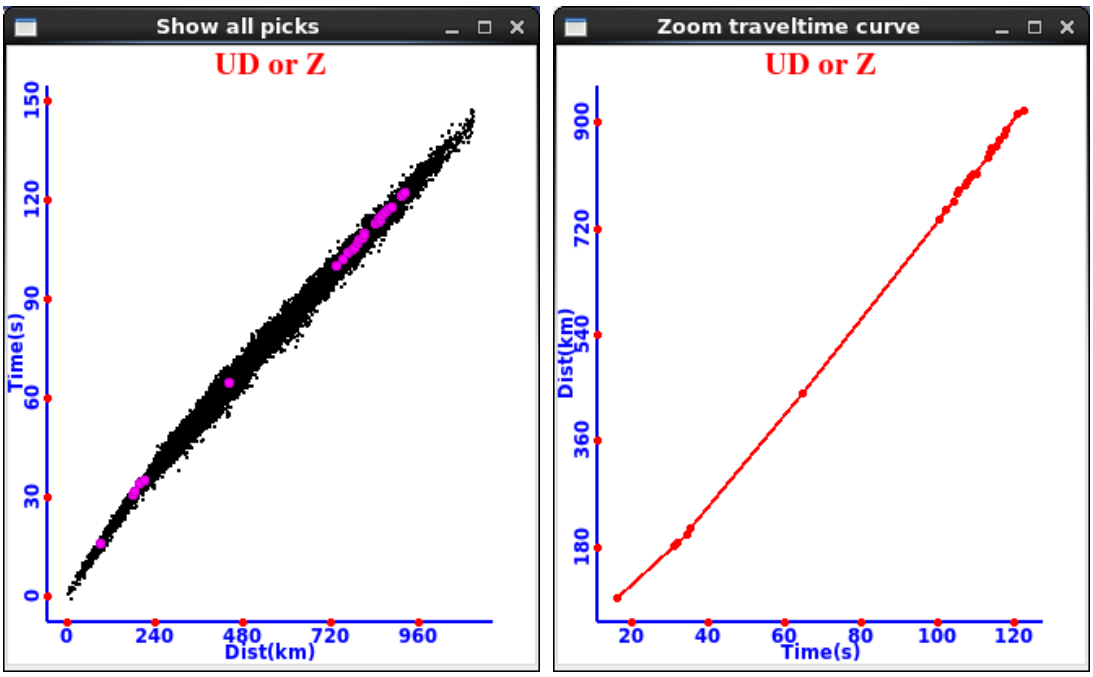


Figure 6. Comparison chart and traveltime curve

Exporting results and its format

TIMCPOT exports results into output folder, the exporting procedures are primarily triggered by three buttons:

By clicking SavePT button, it exports brief information on manual picks, just for relocation procedure.

By clicking Locate button, it exports relocation results.

By clicking OutAll button, it exports complete information on manual picks, event locations, and figures.

The file list is as following:

PKTRLOC: manually picking traveltime, brief information just for relocation

PKTFINAL: manually picking traveltime, complete information for tomographic study

EVTRLOC: event location derived from relocate procedure

EVTFINAL: the optimal solution for event location

EVTSACF: event location stored in SAC file

STATION: station sketch figure

WAVE: waveform profile figure

PKTCMP: comparison chart for manual picks

There is an indicator (Figure 7) displaying if these files were exported or not. ZZ is for up-down component. ET is for east-west component. NR is for north-south component. If two horizontal channels of seismic data were rotated, then ET is for tangential component while NR is for radial component.

Manual picks and event locations are saved as text format which can be opened in any text editor. Figures are saved as postscript format, if command 'ps2raster' is available in user's Linux system, a copy of figures will be converted to JPG format files.

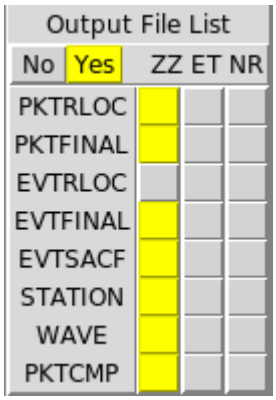


Figure 7. Indicator for file list

Manual picks are written out in text format as following:

```
51045   27.1000   106.9000  1.3310 1    113.620 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.1733   256.4213    73.0415
51030   27.8000   105.6000  1.2580 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.2914   247.1464    64.3030
53034   25.8000   100.5000  1.5420 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    1.3180   243.3234    62.7668
51032   27.7000   106.3000  0.8880 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.8333   250.2374    67.0879
53030   26.4000   100.2000  2.0920 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    1.4969   217.2473    36.8144
51036   27.4000   106.1000  1.5840 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.5687   252.0643    69.0201
51014   28.6000   106.4000  1.2000 1    114.828 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.2648   243.8815    60.6365
51009   28.9000   106.1000  0.3430 1    112.758 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.1706   240.6806    57.5548
51026   28.0000   105.8000  0.6520 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.5328   246.2345    63.2917
51020   28.3000   105.8000  1.1150 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.6588   243.8906    60.9321
51034   27.7000   107.0000  0.8940 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.4289   252.1689    68.7002
51031   27.7000   106.8000  0.9040 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.5837   249.3169    66.3008
51033   27.7000   106.6000  1.0810 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.0843   251.0976    67.8148
51027   28.0000   106.1000  1.1230 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.7765   247.2721    64.1952
53040   25.4000   100.5000  1.6900 0    31.329 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    1.1935   260.6712    80.1187
51018   28.2000   105.2000  0.4670 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.1417   242.2632    59.5789
51004   29.1000   106.8000  0.4210 1    122.074 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    7.8042   241.9284    58.4728
51012   28.6000   105.7000  0.5360 0 -12345.000 2011 171 10 16 49 000  8.500 2011 171 10 16 57 500    25.2000   99.2000   9.0  5.3  20110620.171.10.16.49.000_5.3  0.2000    6.7184   241.2349    58.3060
> 20110620.171.10.16.49.000_5.3
```

Explanatory notes to this text format are as following:

column #1: station ID, also known as STAID, station name and *kstnm*.
column #2-4: *latitude, longitude* and *elevation* for station.
column #5-6: switch (0/1), traveltime of manual picks.
If switch is equal to 0, the manual pick is not available or seismic waveform signal noise ratio is too low to identify a phase onset time.
if switch is equal to 1, an available manual pick is identified.
column #7-12: reference time point for manual picks, listing in order of *year, Julian day*, *hour*, *minute, second, millisecond.*
column #13: time shift of event, refer to the time point appointed in column #7-12.
column #14-19: a time point when event occurred. An analogic equation for time is
(column #7-12) + column #13 = (Column #14-19)
column #20-23: *latitude, longitude*, *depth* and *magnitude* for event.
column #24: event ID, also known as EVTID.
column #25: data sample of seismic data from which user measured phase onset time.
column #26-28: distance, back-azimuth, and azimuth between station and event.

The last line is just a repetition of EVTID, but it begins with a char ">".

The above explanatory notes are for complete information on manual picks saved in PTKFINAL. PKTRLOC contains brief information on manual picks, thus column #1-12.

Event locations are written out in text format as following:

```
20110620.171.10.16.49.000_5.3 2011/06/20 10:16:57.500    99.2000    25.2000   9.000    99.2000    25.2000   8.000  0.000000   1.00
```

Explanatory notes to this text format are as following:

column #1: event ID, also known as EVTID.
column #2-3: date and time for event.
column #4-6: position1 (longitude1, latitude1, and depth1) for event.
column #7-9: position2 (longitude2, latitude2, and depth2) for event.
column #10: distance between position1 and position2.
column #11: difference between depth1 and depth2, that is depth1 minus depth2.

The above explanatory notes are for event locations saved in EVTRLOC.
EVTFINAL and EVTSACF contains the first six columns, thus column #1-6.

Known problems

In current version (Version R1.0), relocation procedure is only applied to P-wave first arrivals. While measuring S-wave phase onset time, and if user wants to relocate hypocentral position, user should conduct relocation through P-wave first arrivals. Actually, it is the most case in seismological community, since P-wave phase onset time is clearer and easier to be identified in comparison to S-wave. Anyway, we have a plan to develop a subroutine which can inverse hypocenter through S-wave first arrivals.

User’s feedback

If user has any questions or problems when using TIMCPOT, please feel free to let me know. If user provides bug report, please attach test data and several specific operations which could trigger the bug. Innovated ideas to improve TIMCPOT are also welcome. The updated version is accessed by sending email to me. Not limitation to the mentioned above, for anything about TIMCPOT, user can contact me via email (zhangfengxue336@163.com).