

Manual of Clipped Waveform Pickup and Restoration

(CWPAR)

Version 1.0

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Introduction

This package (CWPAR) will help user to pick up the clipped seismic waveform and then restore the waveform using POCS method. For more details of technic, please refer to: *Zhang, J. H. et al., 2016, Restoration of clipped seismic waveforms using projection onto convex sets method, Scientific Reports, 6:39056, doi: 10.1038/srep39056* [【PDF】](#)

This code would deal with the clipped waveform one by one, and the intermediate results would be replaced automatically. It has two branches: one is to manually define (or pick up) the beginning and ending positions for each clipped segments via an interactive window, and the other is to restore the waveform using the POCS method.

Illustration of using CWP

Step 1.

Copy the clipped seismic data file in SAC format to current directory.

Step 2.

Open the main program “CWP.m” in Matlab[®] environment, and change the name of the input SAC file from

```
fileIn = '2011.074.13.27.10.0195.IU.MAJO.10.BHZ.M.SAC'
```

to

```
fileIn = 'Your Own File.SAC'
```

Meanwhile, change the output file name into what you want. We suggest using an extension of “-Restore” to the input file name for the convenience of distinguishing between them, which may look like

```
fileOut = '2011.074.13.27.10.0195.IU.MAJO.10.BHZ.M-Restore.SAC'
```

Step 3.

Set “route=1” in “CWP.m” if you still did not manually pick up the clipped positions; otherwise, set “route=2”.

Step 4.

If route=1, the user will see a new window, as shown in **Figure 1**.

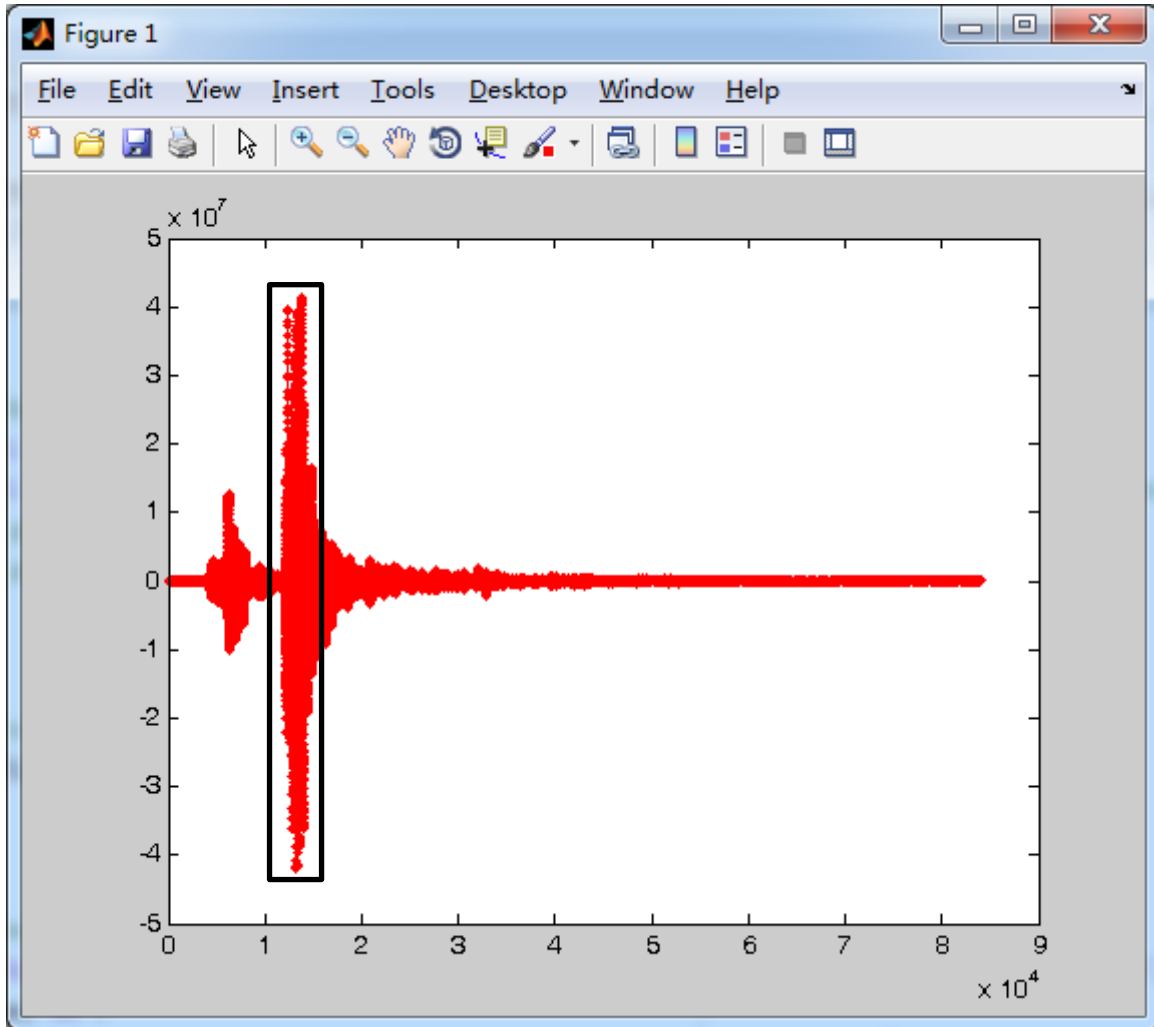



Figure 1. The clipped seismic waveform.

Push down the button  and then select an area to zoom in, for example, around the maximum peaks (say within the black box in **Figure 1**), where the amplitude is easy to be clipped due to the limitation of dynamic ranges of seismometer. We will see **Figure 2**.

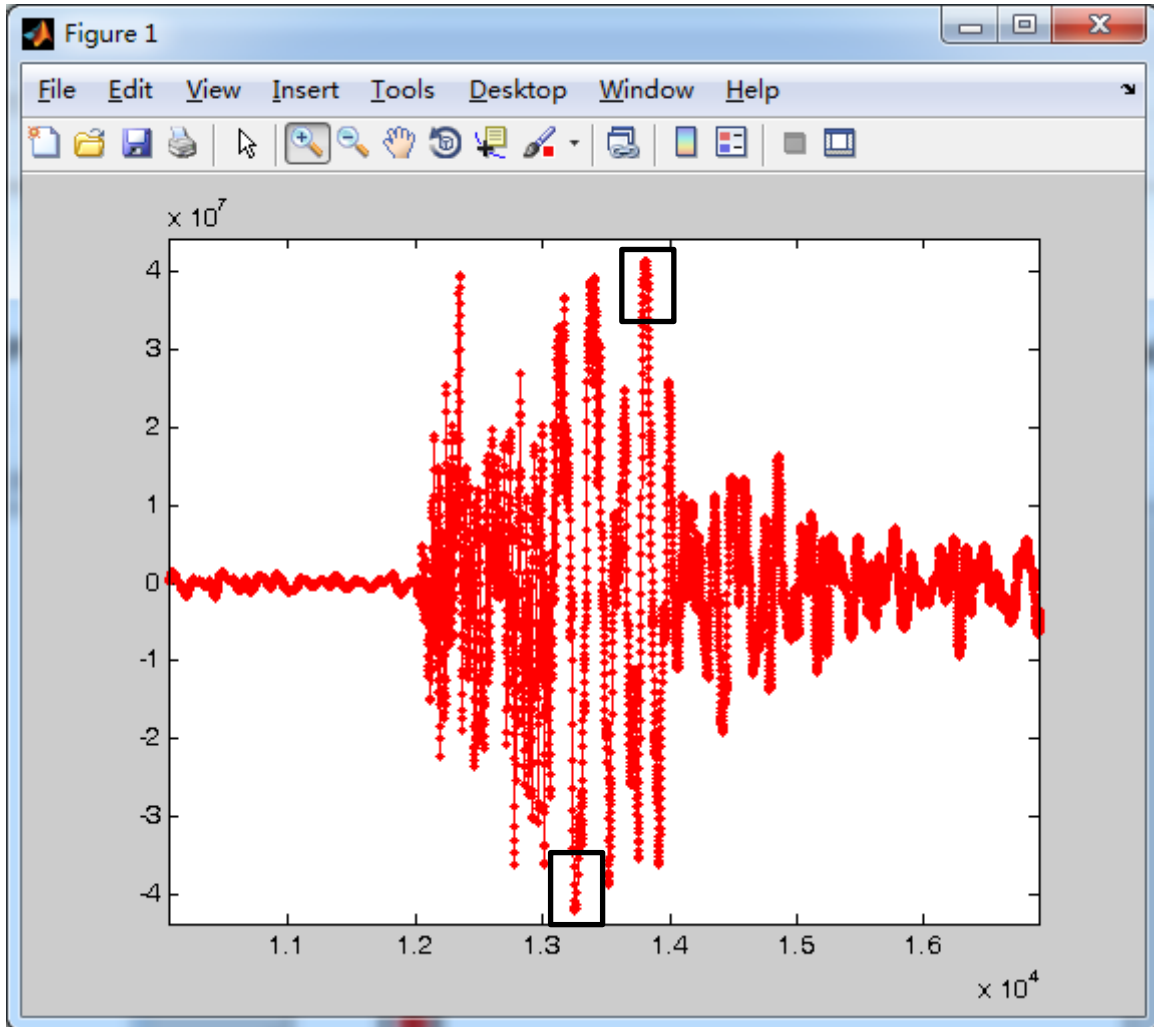


Figure 2. Local zoom in of the black box shown in Figure 1.

The user can further zoom in and check through the whole waveform to find out all possible samples that are clipped. Then, you can zoom in around the local positions that are clipped (say the two black boxes in **Figure 2**) and begin to pick up the beginning and ending of the current clipped segment. For the left bottom box shown in **Figure 2**, we can see **Figure 3**.

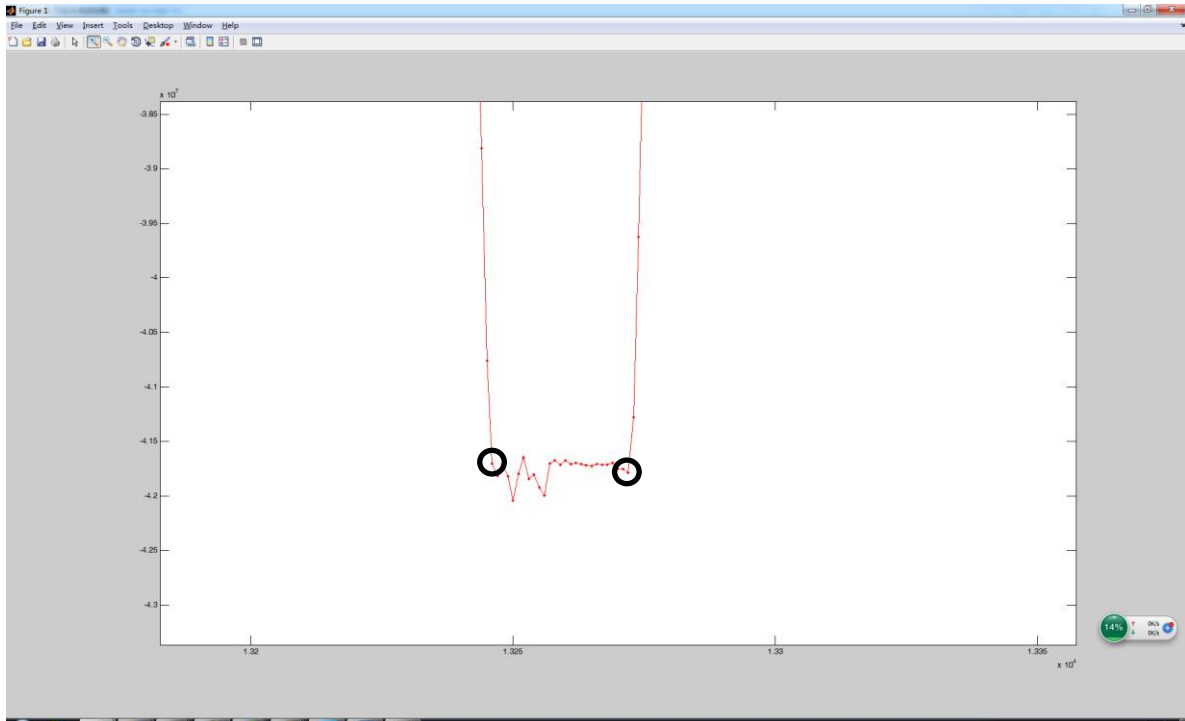



Figure 3. Local zoom in of the left black box shown in Figure 2.

Click  again to quit the zoom-in mode and turn to “pick-up” mode. For each segment of clipped waveform, click the left button of mouse around the two black circles, shown in **Figure 3**, from left to right in sequence, and their positions (or indices in the array) would appear in *Command Window*. Then, move to another clipped segment to mark the beginning and ending positions. Make sure that all these marked positions should be in an incremental sequence by picking up from the most left to the most right for each clipped segment. The odd index for each clipped segment should be the beginning and the even index should be the ending of the clipped segment. In other words, the beginning and ending positions of the segments of clipped

waveform should appear in couple and in sequence. Finally, close the figure after you had marked all clipped segments. Remember to copy and save the numbers in *Command Window*, shown in **Figure 4**, into the file "flagZ.txt".

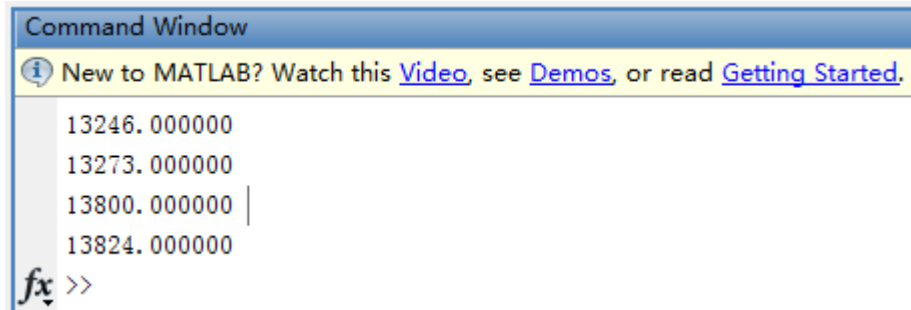


Figure 4. The picked-up indices of the beginning and ending samples of the clipped segments.

Step 5.

Set "route=2" in "CWPAR.m", and run the code again. You will get

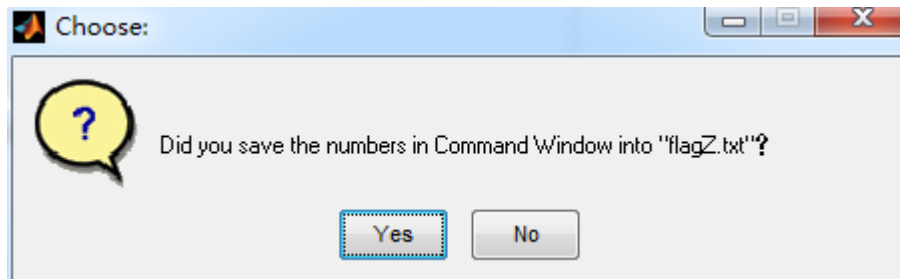


Figure 5. The dialogue window.

If you had saved the numbers in *Command Window* into the file "flagZ.txt", please click "Yes" in **Figure 5** to continue; otherwise, repeat **Steps** 1 to 4 to generate a valid "flagZ.txt" and then move to **Step 5**. After several seconds or minutes, you will get the restored waveform, which would be shown

together with the input with different colors, as shown in **Figure 6**. Find the restored result in the output file “fileOut”.

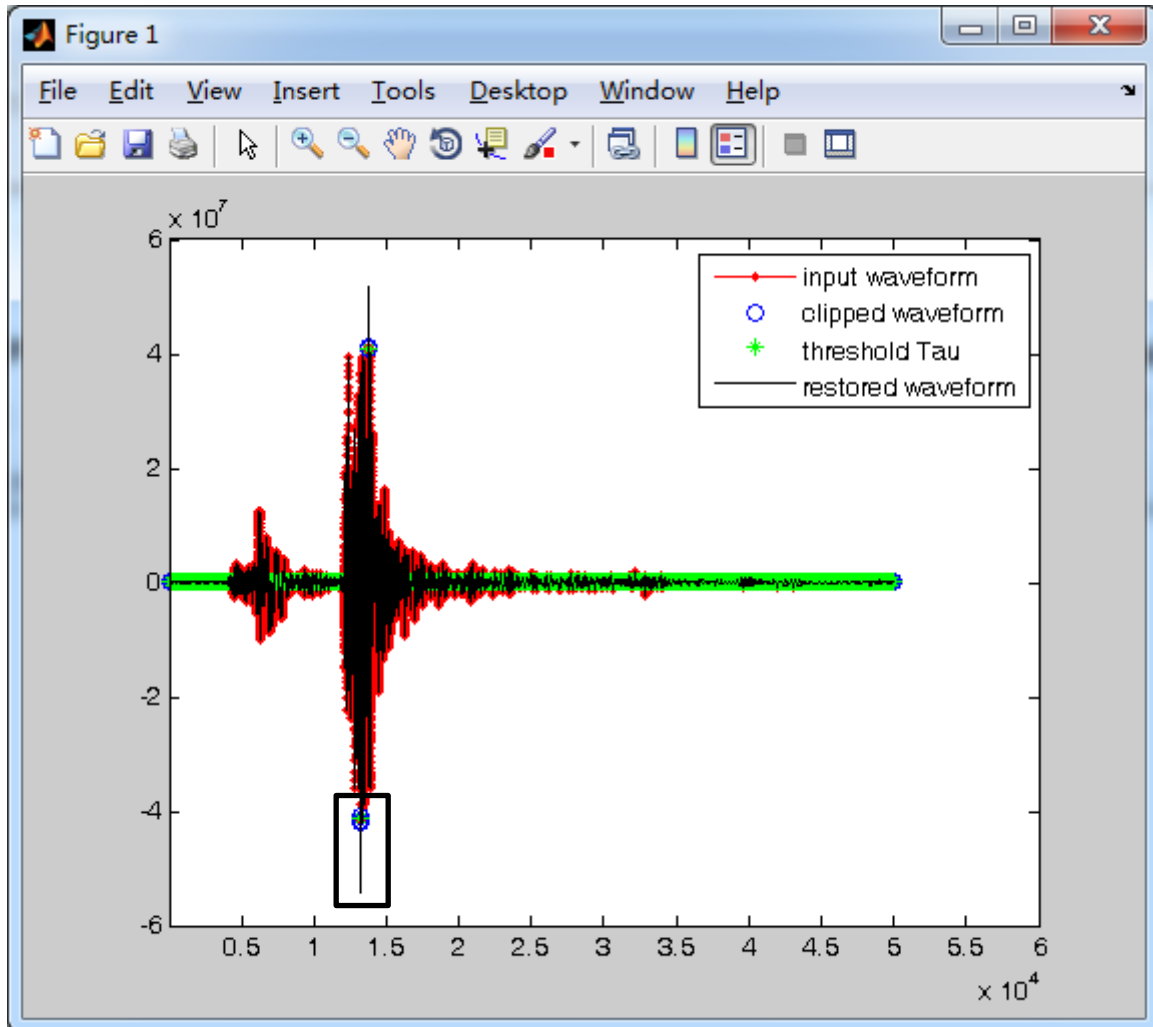



Figure 6. The comparison between the clipped and restored waveforms.

Step 6.

Push down the button  to zoom in and check all clipped segments (say, the black box in **Figure 6**), as shown in **Figure 7**. If you are satisfied with the restoration result, close the figure and move to a new seismic waveform;

otherwise, try to pick up the clipped samples at different beginning and ending indices, until satisfied. User should include more samples (e.g. 3~5 on each side the segment of the clipped waveform) rather than less to obtain a reasonable restoration result.

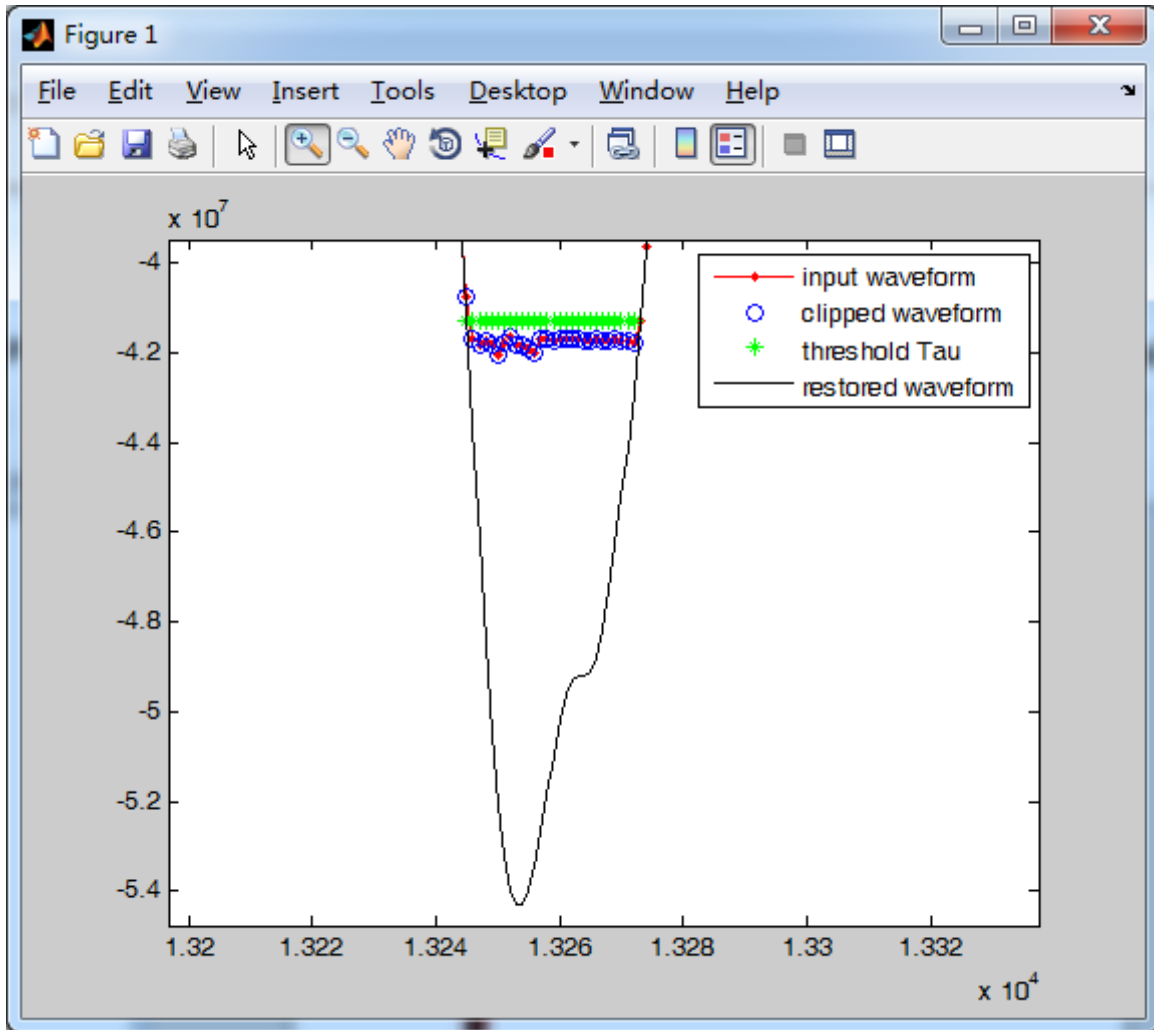


Figure 7. Local zoom in of the black box shown in Figure 6.

Please contact Jinhai Zhang for any problem of using CWPAP.

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http://sourcedb.cas.cn/sourcedb_igg_cas/en/zjrck/201001/t20100119_2728795.html