1. Introduction

This is a manual to briefly describe the installation and usage of Frequency Detection Code (Linville et al., 2014; Linville et al., 2018). It has been modified to work on a local archive (Trow et al., 2018) instead of using only the EarthScope Transportable Array.

2. Setup anaconda environment

The code requires several python-packages to run. To create an anaconda environment at your local machine run **00.setup.sh** script. This will create an anaconda environment named **freqtor** for python 2.7.11 and will install the appropriate versions of **obspy 1.0.2, pandas 0.19.2, geopy 1.11.0, basemap 1.0.7, Ipython 4.1.2, Ipykernel 4.3.1,** and **matplotlib 1.5.2.**

Attention! To install anaconda at your local machine follow the instructions given in https://uuss-wiki.seis.utah.edu:8089/trac/wiki/Anaconda/Obspy (or ask the sys-admin).

CHPC

For installing anaconda in CHPC follow the instructions given in

https://www.chpc.utah.edu/documentation/software/python-anaconda.php
Then you can install the environment using **00.setup.sh** (change the path in line 10) or install the packages manually.

Tip: For chpc run please add in the **detection_script.py** the following lines (right under #control plot behavior):

```
import matplotlib
matplotlib.use('Agg')
```

This will allow you to use matplotlib without Xserver.

To activate the installed environment type:

```
conda activate freqtor
```

To deactivate

```
conda deactivate
```

3. Organize data

To organize the data into folders use **01.organize.sh.** Examples of folder structure and filenames are given in 20161218/ and 20161219/ directories. Each directory should be named as *YEARMONTHDAY*. Each sac file should be *YEARMONTHDAYHOURMINSECMSEC.STATIONNAME.COMPONENT.NETWORK. sac* (e.g. 20161218004549680.5.EHZ.FG.sac).

4. Run freqtor

To run the detection code execute **02.run_freqtor.** Edit only the parameters in the script.

Table 1 Parameters used in frequency detector code

Parameter Name	Description
answer	1 to run locally 2 to run in chpc using multiple cores
datdir	Specify the path of the data archive
yr	Set the year of the dataset
mo	Set the month of the dataset
dy	Set the starting day
hr	Set starting hour (default=00)
mn	Set starting minute (default=00)
sc	Set starting sec (default=00)
days	Total number of days to perform detections
duration	Duration of the waveforms (default= 86400 for one day)
deltaf	Sampling rate of the dataset
freq1	Minimum frequency used to sum the normalized amplitudes
freq2	Maximum frequency used to sum the normalized amplitudes
thresholdv	Area threshold
masktimes	Multiplies N times the average interstation distance
madtimes	Multiplies N times the Median Absolute Deviation
time_thres	Time detection threshold in seconds
distance_thres	Distance detection threshold in meters

5. Visual inspection

Few hours later you will hopefully get a few detections and it is time to visually inspect them and decide if it is an earthquake or a false alarm. Run **03.selectgood.sh** to go through all the .png files.

0: False detection

1: Earthquake

References

Linville, L., Pankow, K., Kilb, D., & Velasco, A. (2014). Exploring remote earthquakes triggering potential across EarthScopes' Transportable Array through frequency domain array visualization. *Journal of Geophysical Research*, *119*, 8950–8963. https://doi.org/10.1002/2014JB011529.Received

Linville, L. M., Pankow, K. L., & Kilb, D. L. (2018). Contour-Based Frequency-Domain Event Detection for Seismic Arrays. *Seismological Research Letters*, *89*(4), 1514–1523. https://doi.org/10.1785/0220170242

Trow, A. J., Zhang, H., Record, A. S., Mendoza, K. A., Pankow, K. L., & Wannamaker, P. E. (2018). Microseismic Event Detection Using Multiple Geophone Arrays in Southwestern Utah. *Seismological Research Letters*. https://doi.org/10.1785/0220180065