PHY408 Lab Four: Cross-correlation and Spectral Analysis

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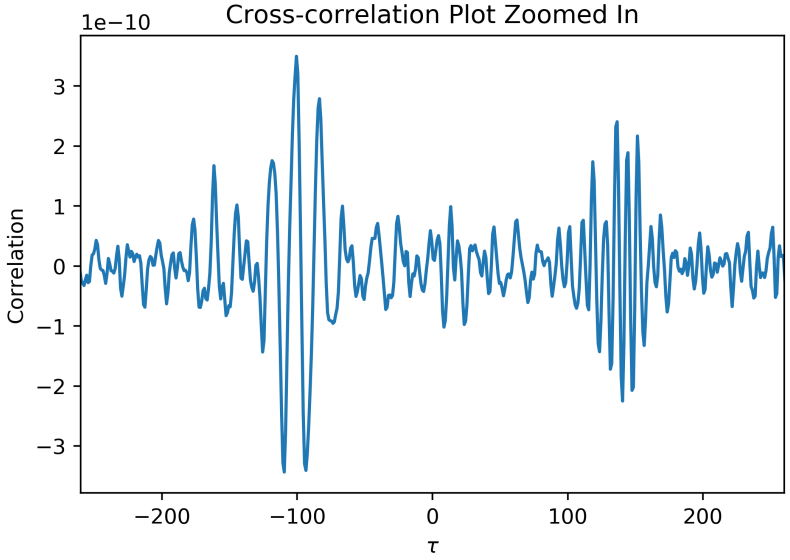
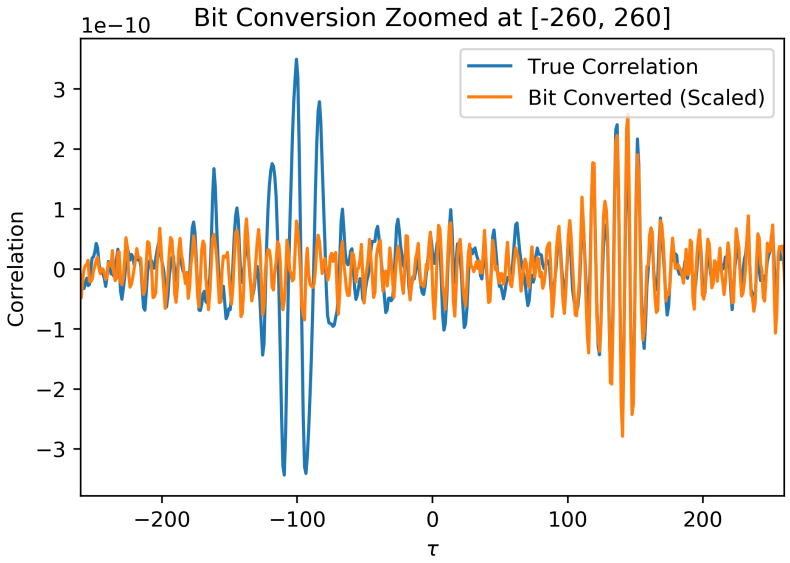
1 Cross-correlation

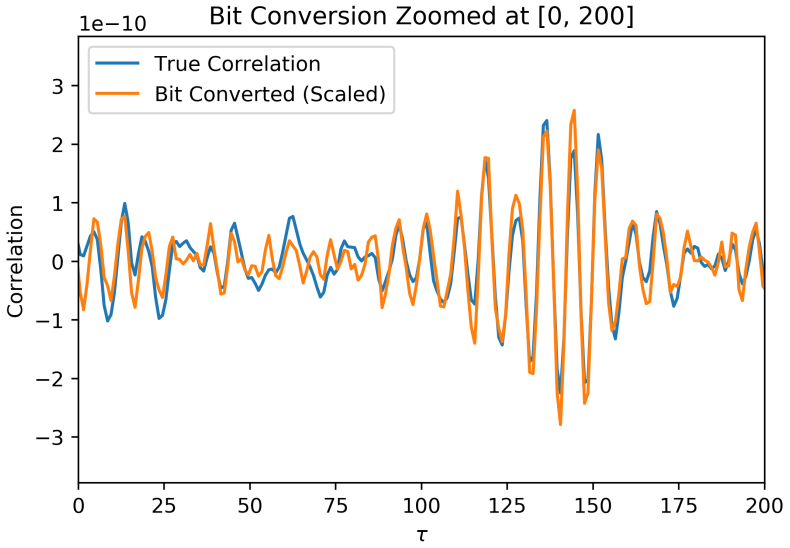
Collaborators: Will Zeng.

1. The zoomed in plot between [-260; 260] seconds is shwon below:



2. After applying bit conversion to the PHL and MLAC data, the results does preserve the phase information compared to the original results. For certain intervals, the bit conversion method preserves the phase information of the true cross-correlation almost perfectly, I have included the plot of the interval from 0 too 200 below, an interval where the results are particularly good.



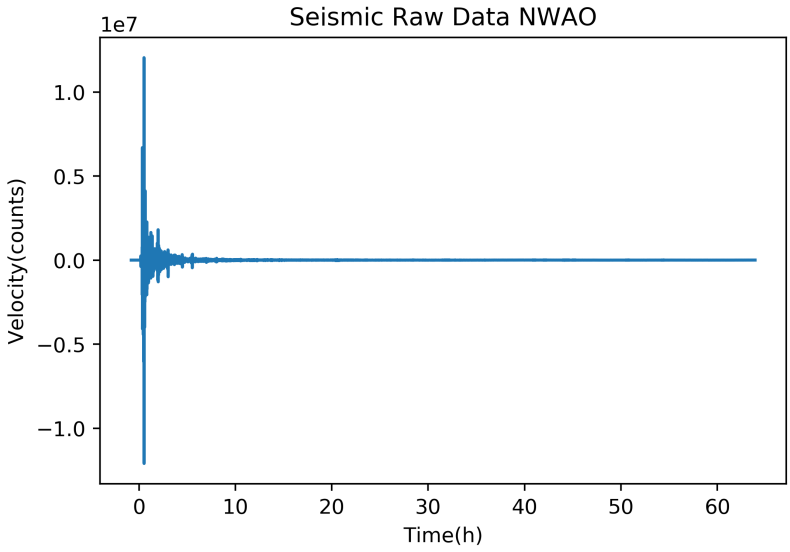


Note: Since the amplitude of bit converted cross correlation has no meaning, I changed the amplitude by a factor of 1.5×10^{12}.

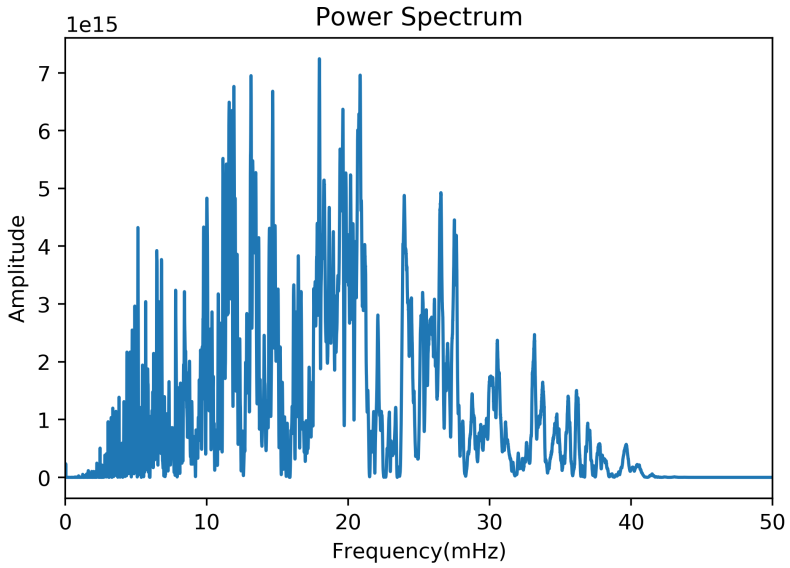
2 Normal Modes from Long Period Seismometer

Collaborators: Will Zeng

1. The plot of raw data with a time axis in hours is shown below:

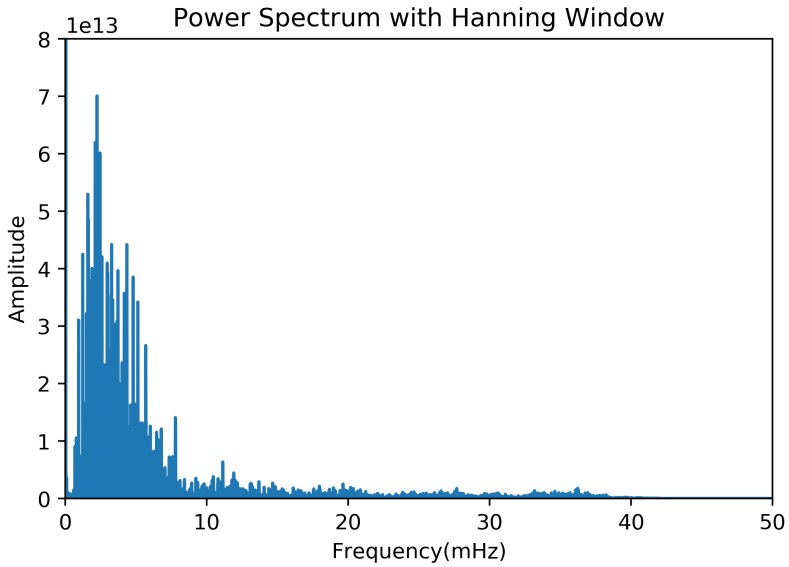


2. The plot of the power spectrum of the raw data as a function of frequency in mHz is shown below:

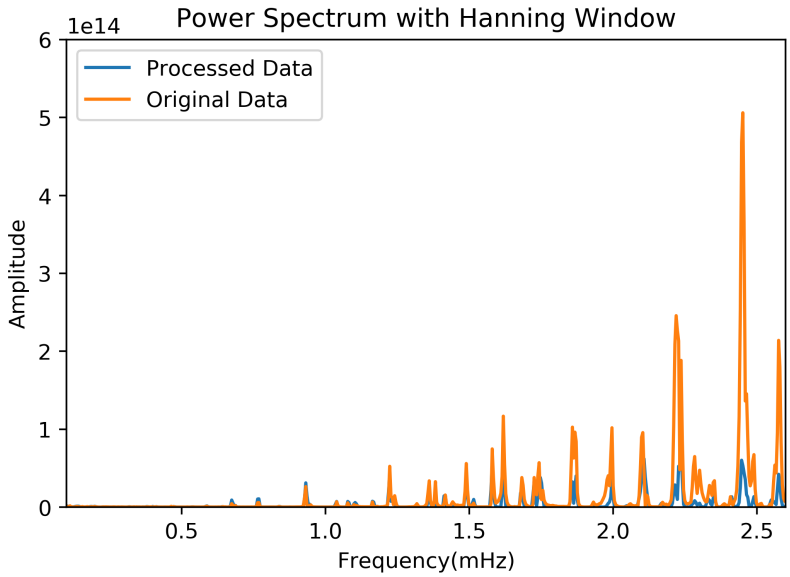


Since the plot is symmetric around $frequency = 0$, I plotted the interval from [0, 50].

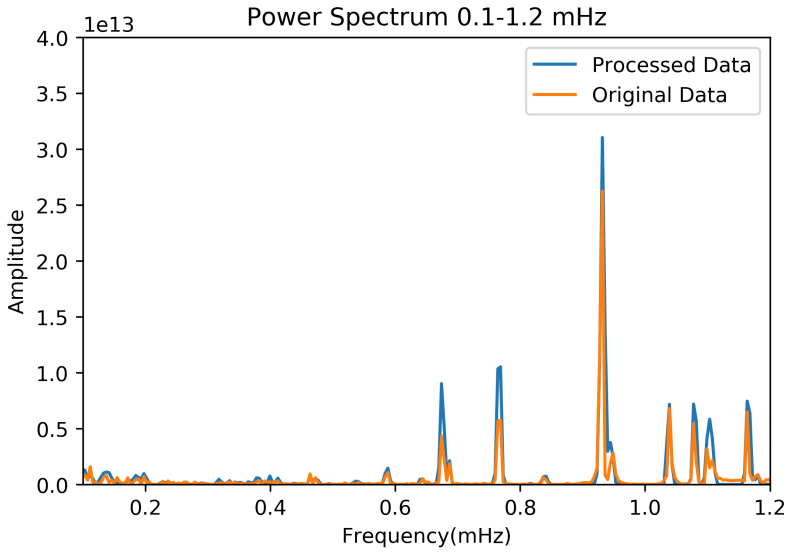
3. After removing the minor linear trend using the same way as Lab 3, I applied the hanning window and obtained the following plot:

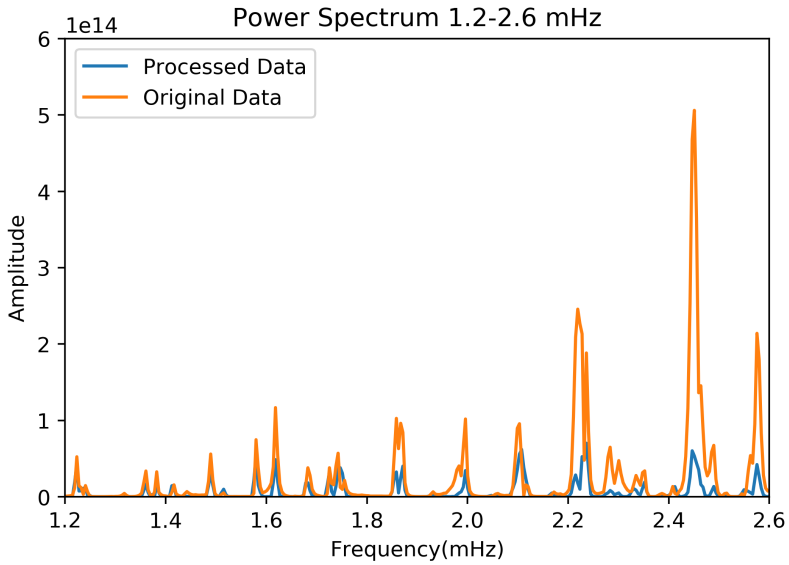


4. The power spectra from 2 and 3 between [0.1, 2.6] mHz is shown below:



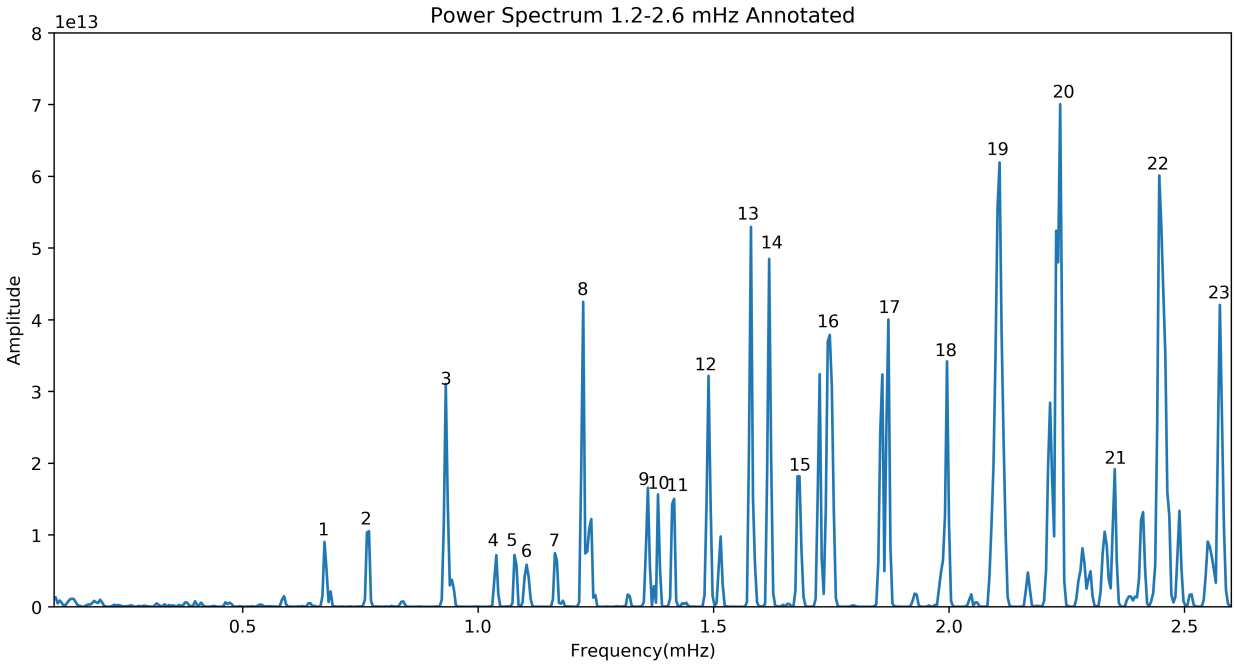
We can see the detrending and applying the hanning window, the processed data has a much smaller amplitude. For better observations, I divided the plot into two intervals, [0.1, 1.25] and [1.25,2.6].





We can see that for interval [0.1, 1.2], the processed data fits the original data almost perfectly in terms of phase information, because of the hanning window. By detrending, we lose the trend of the original data which resulted in the out of scale interval at [1.2, 2.6], but the peaks are still consistent, which is what we expect.

5. A plot with all the possible normal modes I can see annotated is shown below:


Power Spectrum 1.2-2.6 mHz Annotated
1e13
Amplitude
Frequency(mHz)
0
1
2
3
4
5
6
7
8
0.5
1.0
1.5
2.0
2.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23