

In The Name Of God

# HW04

## Advanced Neuroscience

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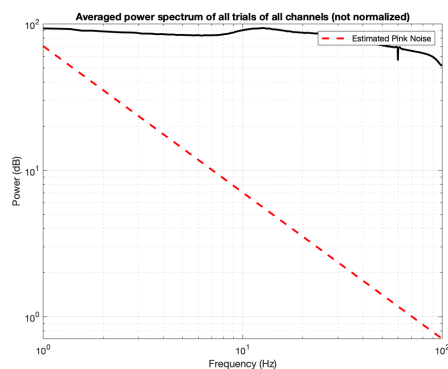
It is noteworthy to mention that I have only used the trials which were marked as clean trial.

### ■ LFP analysis

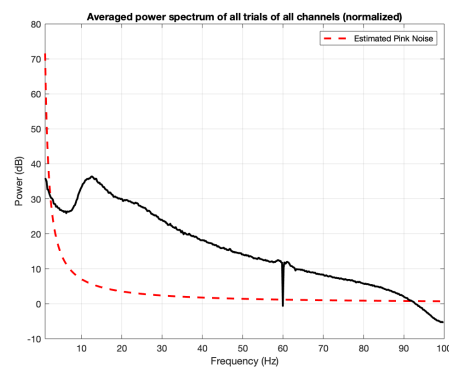
#### □ Part a - Removing Pink Noise

##### Pink Noise

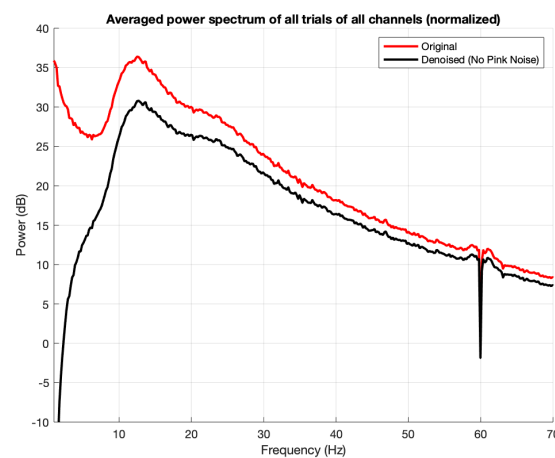
Pink noise or  $\frac{1}{f}$  noise is a signal with a frequency spectrum such that the power spectral density is inversely proportional to the frequency of the signal. In order to removing pink noise, I fitted a line with slope equal to  $-1$  to log-log FFT of the signal and then subtracted this line from the FFT. You can see the fitted line and original and denoised power spectrums of the signal in the figure 1.



(a) Averaged Power Spectrum (Log-Log)



(b) Averaged Power Spectrum



(c) Original and Denoised Power Spectrum

Figure 1: Pink noise, Original Power Spectrum, and Denoised Power Spectrum

As can be seen in the Figure 1, dominant frequency is in the 10 – 15Hz frequency band.

## □ Part b - Dominant Frequency

In order to cluster the electrodes based on their dominant frequency, I calculated FFT of each trial of channels and then plotted the average power spectrum of trials of each channel in Figure 2.

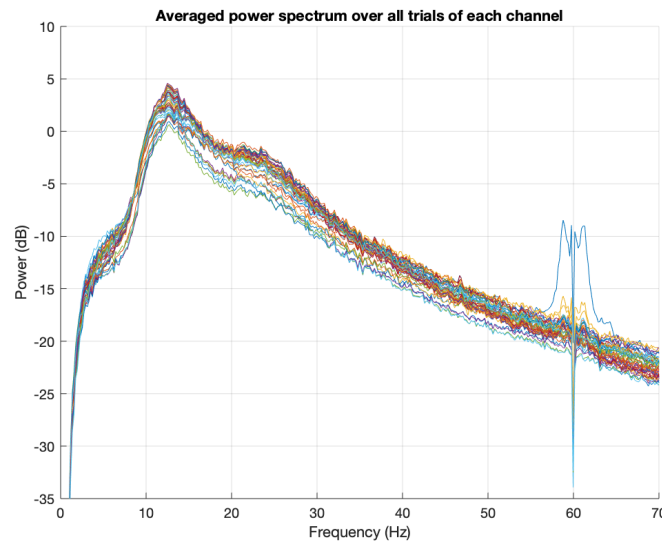


Figure 2: Average Power Spectrum of each Channel

As can be seen in the Figure 2, dominant frequency of all the channels is between 10 – 15Hz.

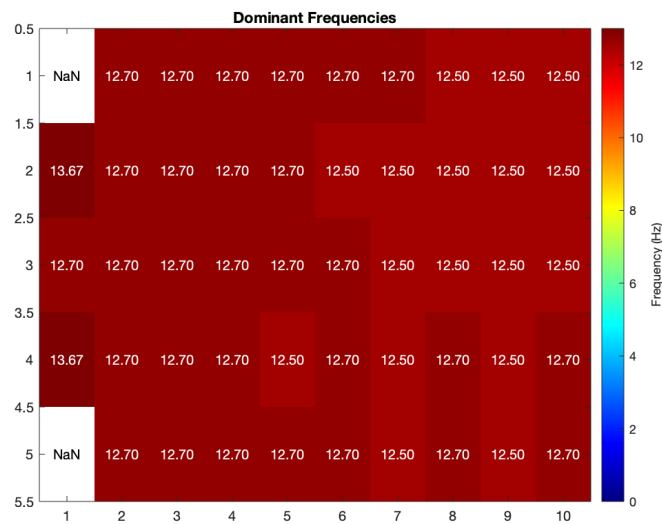


Figure 3: Dominant Frequency of each Channel

As mentioned in the last part, dominant frequency of all of the channels is about 12.5Hz which is in 10 – 15Hz frequency band.

## □ Part c - Time-Frequency Analysis

### Removing Pink Noise

I have removed pink noise in each time-window in both of the methods (STFT and Welch).

#### STFT

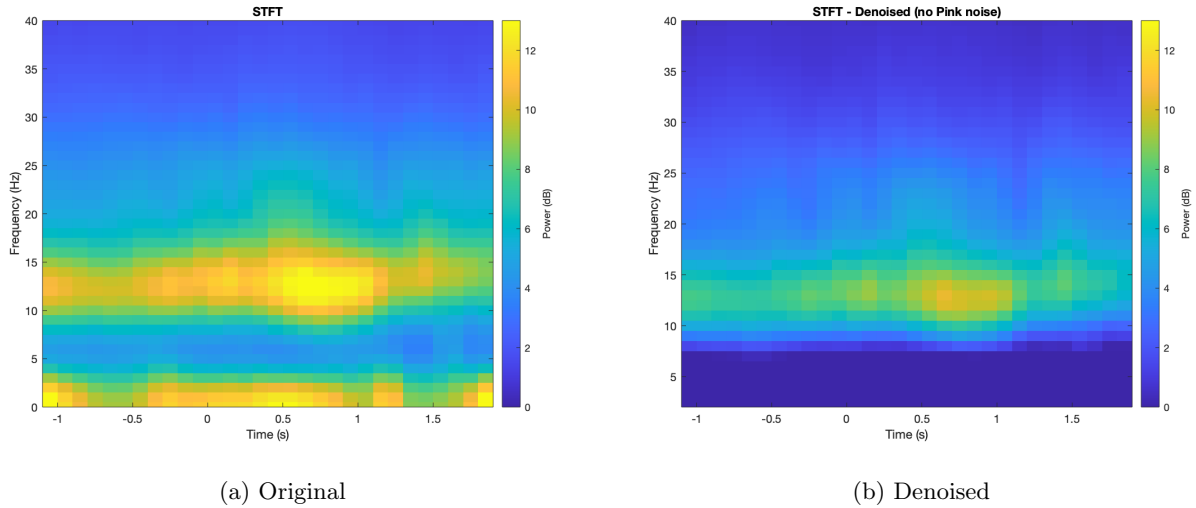


Figure 4: Average Power Spectrum over Time of all Trials of all Channels - STFT

Table 1: Parameters of STFT

Window type	kaiser
Window gain	5
Window size	300ms
Overlap length	200ms
FFT Length	200

Parameters which were used to obtain STFT of the signal are written down in Table 1. While using smaller window sizes gives better time resolution, low frequency components would be missed. so I chose these parameters.

## Welch

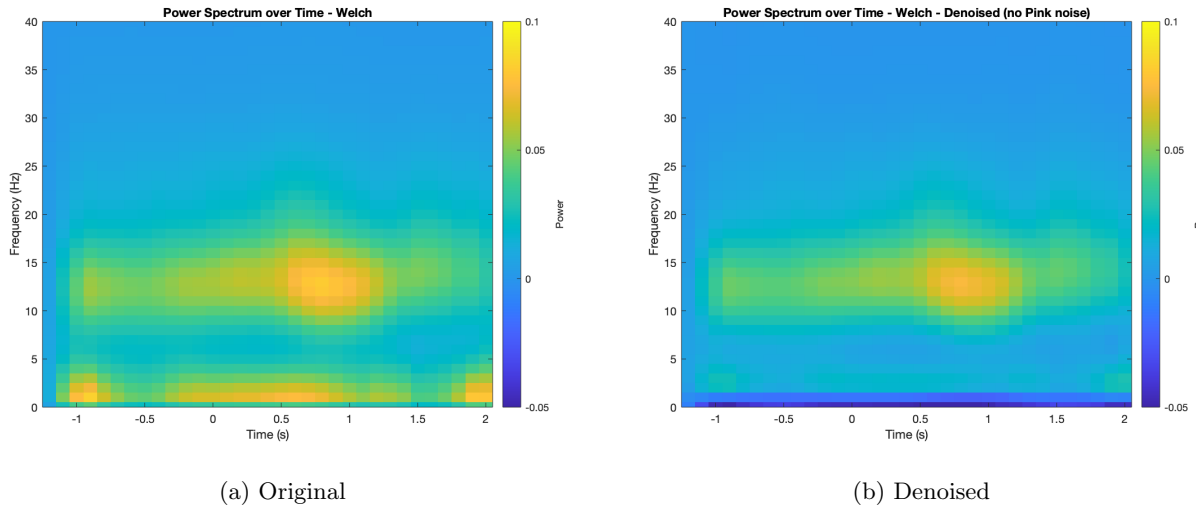


Figure 5: Average Power Spectrum over Time of all Trials of all Channels - Welch

Table 2: Parameters of PWelch

Window size	200ms
Overlap length	100ms
FFT Length	200

As can be seen in the Figures 4 and 5, after 500ms of the onset there is an increase in the power of 10 – 15Hz frequency band.