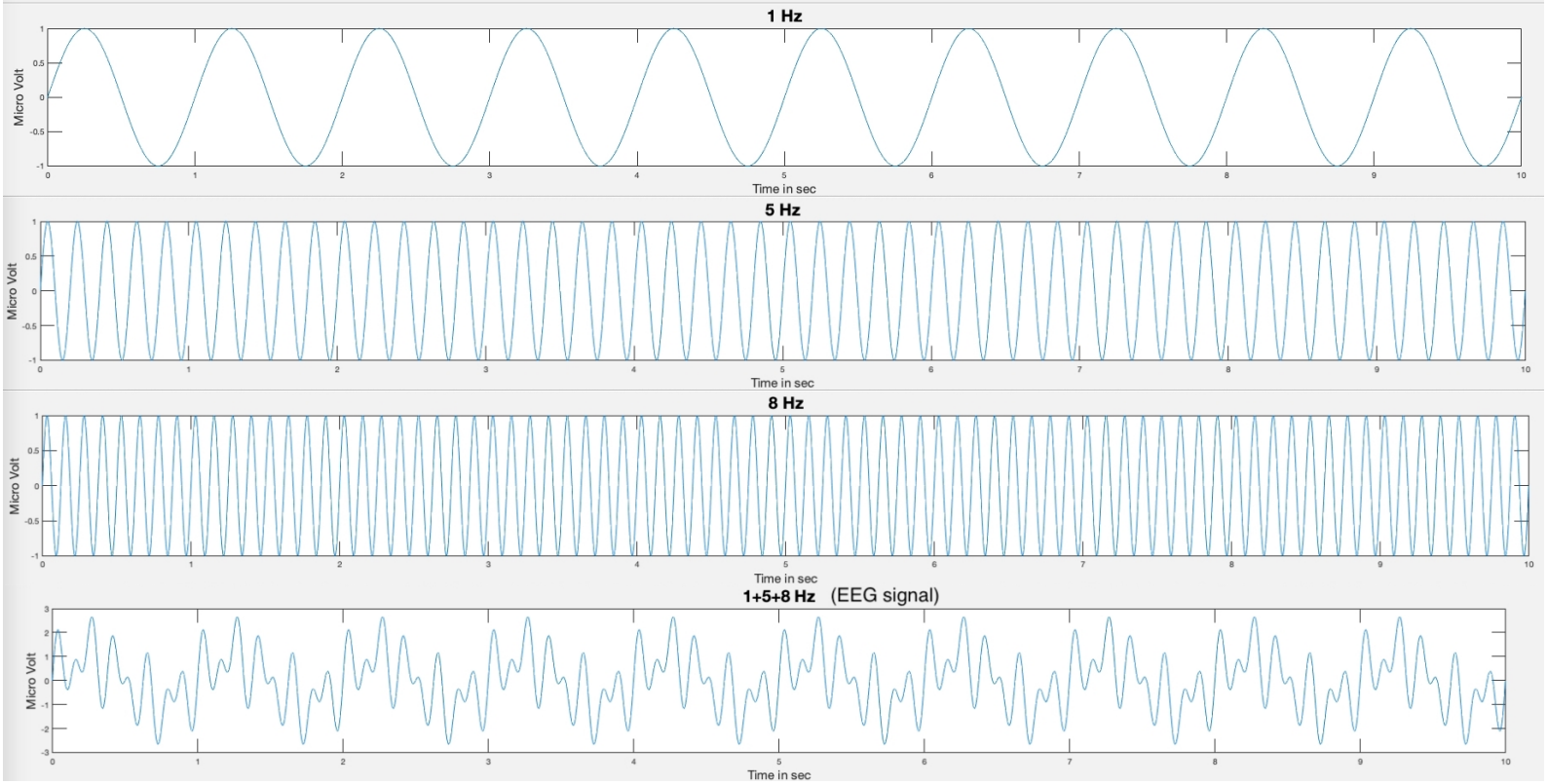
1) When plotting the frequency and time image, the data is filtered or not?

The data is not filtered. We compute dot product between the data and different sine waves.

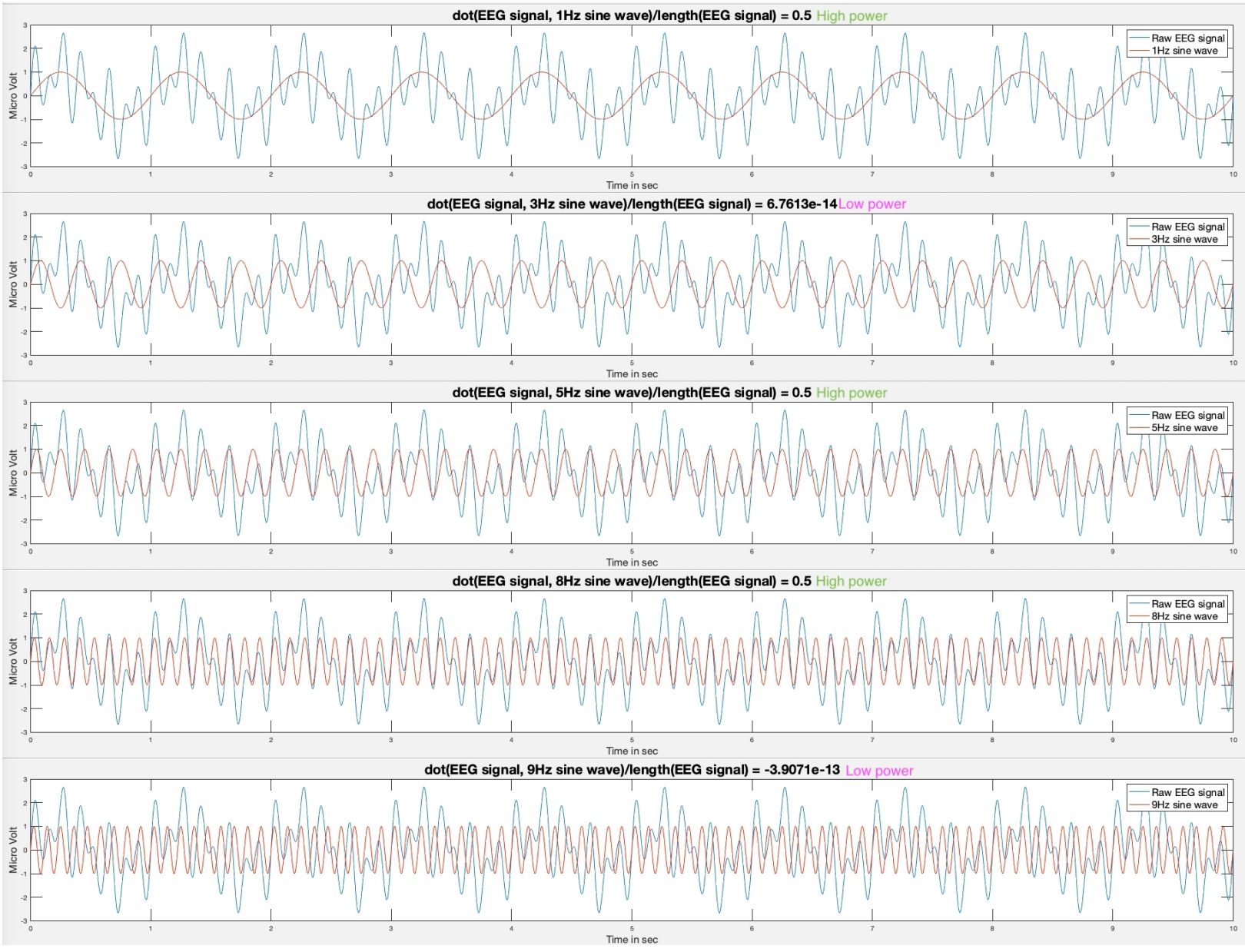
The goal of time-frequency analysis in general is to understand how spectral feature of a signal are changing over time.

EEG signals contain mixed oscillations of different frequencies. Below is an EEG signal in which 1,5,8 Hz frequency are mixed.

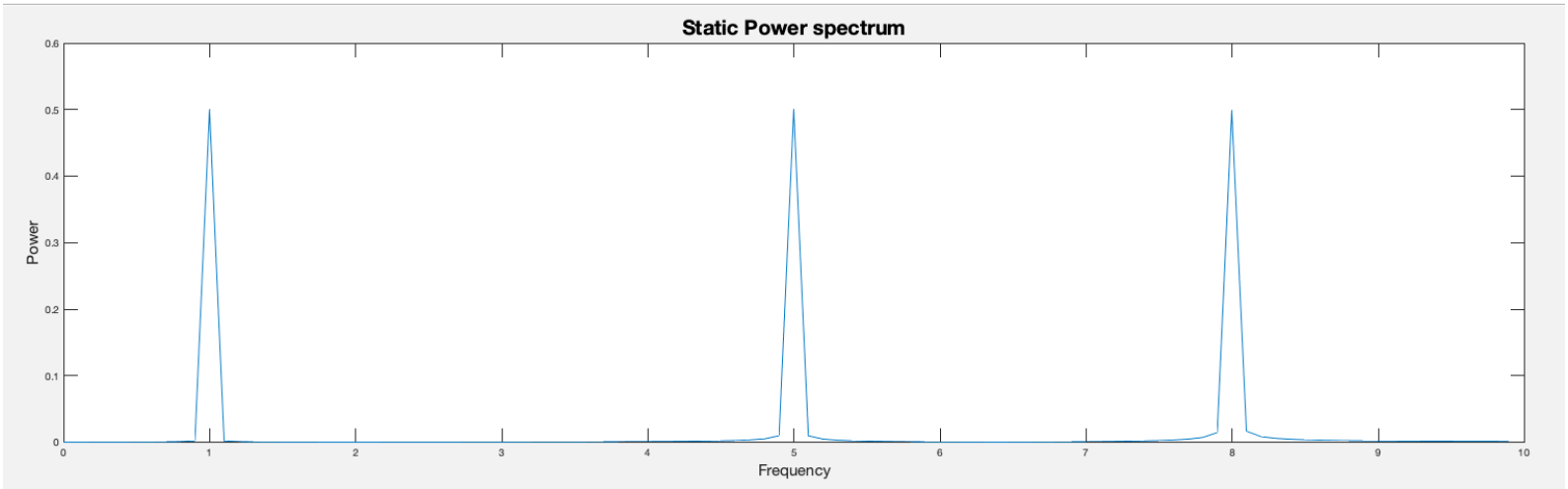


I want to know the dominant frequency oscillations that are present in the EEG signal. In this example we know that the dominant frequencies are 1,5 and 8Hz, but in real world EEG data we don't know what mixtures of frequencies are contained in the signal. We can use power spectrum analysis method to find it. The theory behind the power spectrum analysis is Fourier transform.

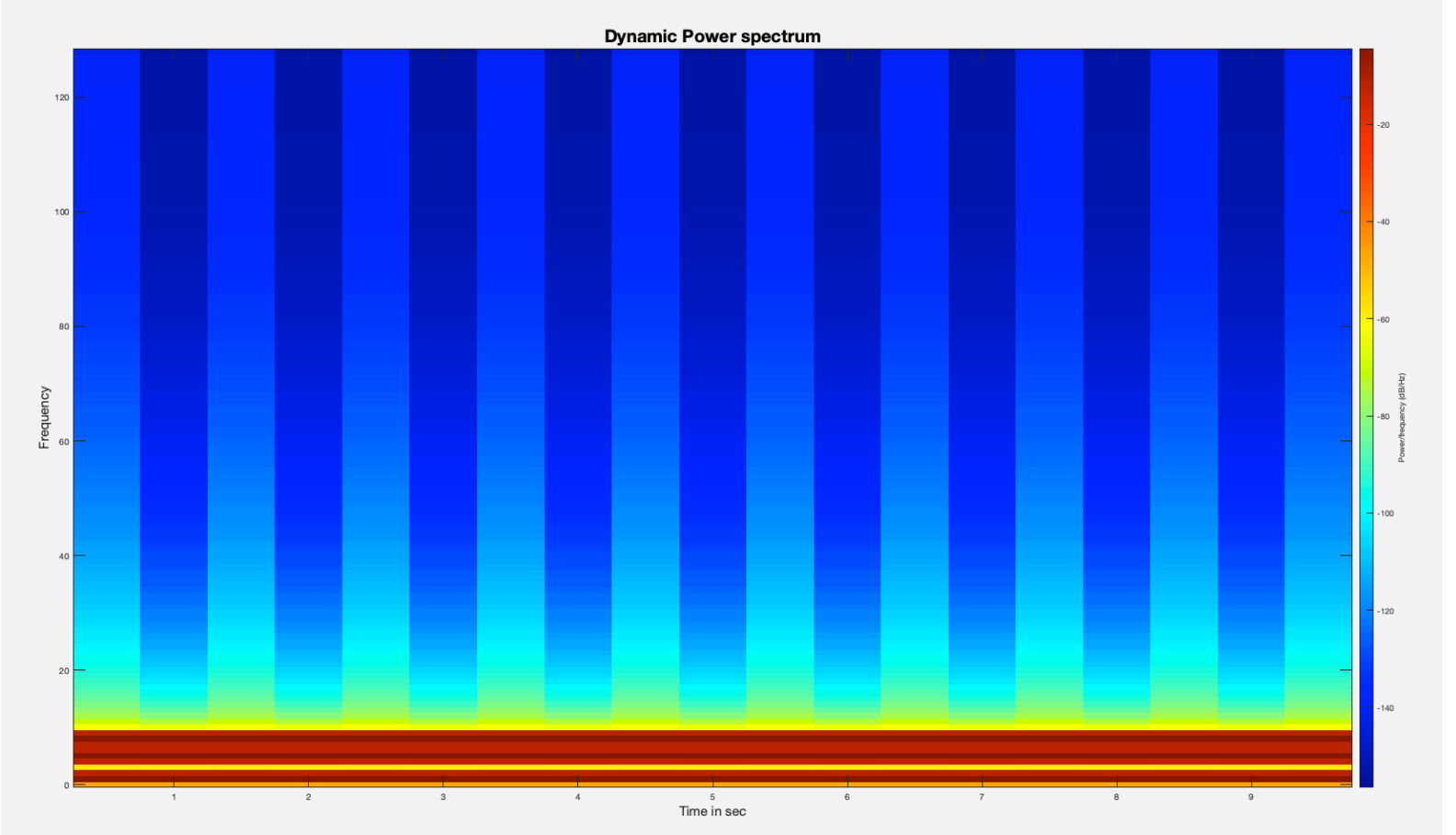
We may think of the *"FOURIER TRANSFORM"* as comparing the EEG signal to sine waves oscillating at different frequencies f. When the EEG signal and the sine wave match, the power at frequency f is large, whereas when the EEG signal and sine wave do not match, the power at frequency f is small. To computer the power, Line up the sine wave with the EEG signal and then compute the dot product between the sine wave and the EEG signal.



When you perform the above dot product procedure for many sine waves of different frequencies, you will finally build the power spectrum.

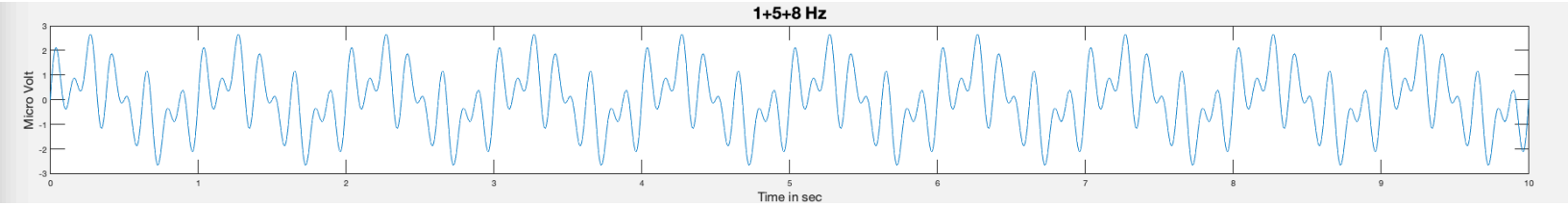


The static power spectrum does not tell us how the power changes over time. We have to perform time-frequency analysis to see how the oscillation power present in the EEG signal changes over time. Below image is called “SPECTROGRAM”. In this example the power in constant at 1,5 and 8Hz.



2) What is the meaning of filtering ?

EEG signal contains multiple signals and noise. The goals of filtering is to isolate the distinct source of signals. For example the below EEG signal contain mixed oscillation of 1,5,8 Hz. Now I want to isolate the 8Hz signal from it. How can I do that ?



We can use IIR butterworth filter to isolate 8Hz signal