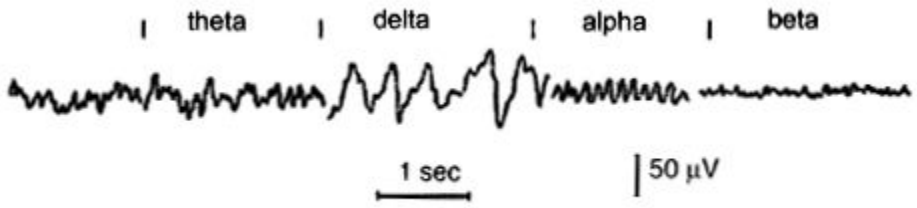


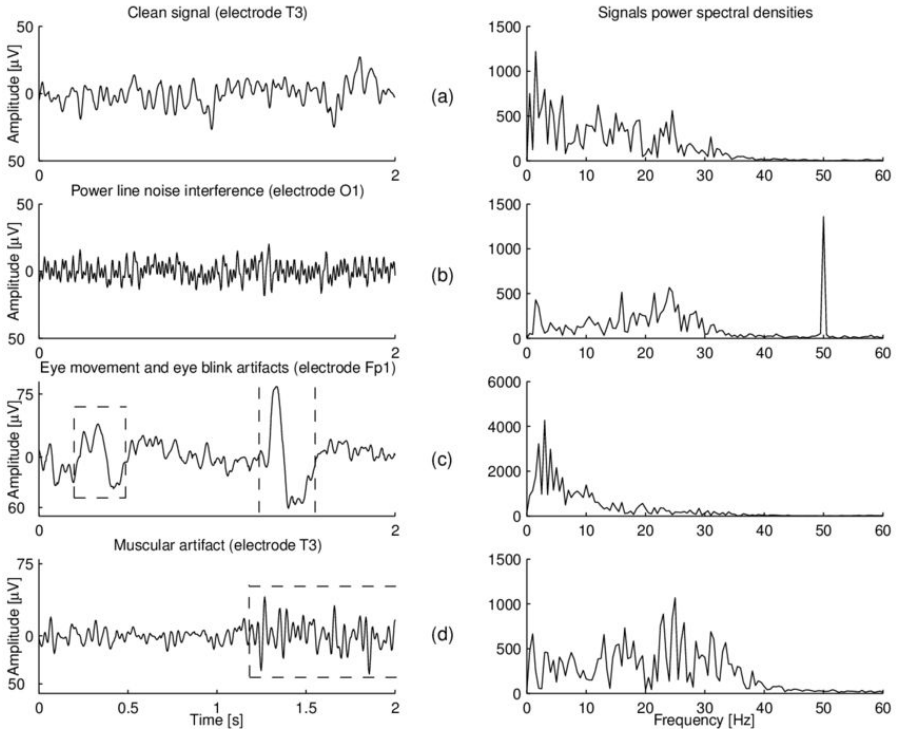
Filtering raw EEG data

Using electroencephalogram (EEG) datasets

Nick Porter

The need to pre-process raw EEG data:

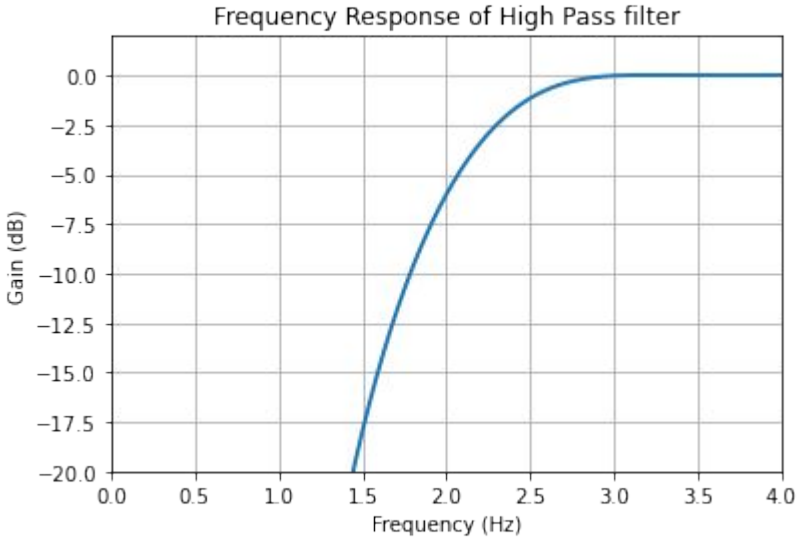
- Remove DC offsets and voltage drift
- Remove spike from power frequency
- Smooth high frequency noise
- Make it easier for an algorithm to successfully identify when specific frequency ranges occur

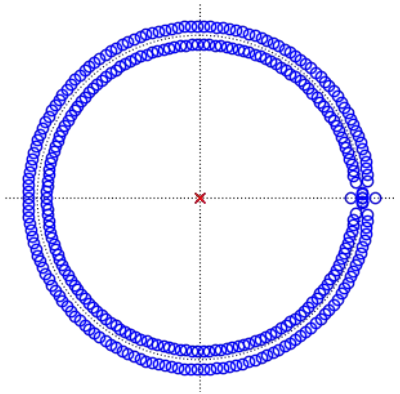


High-pass filter specifications

- Cutoff set to 3Hz
- 2Hz transition band
- Hamming window

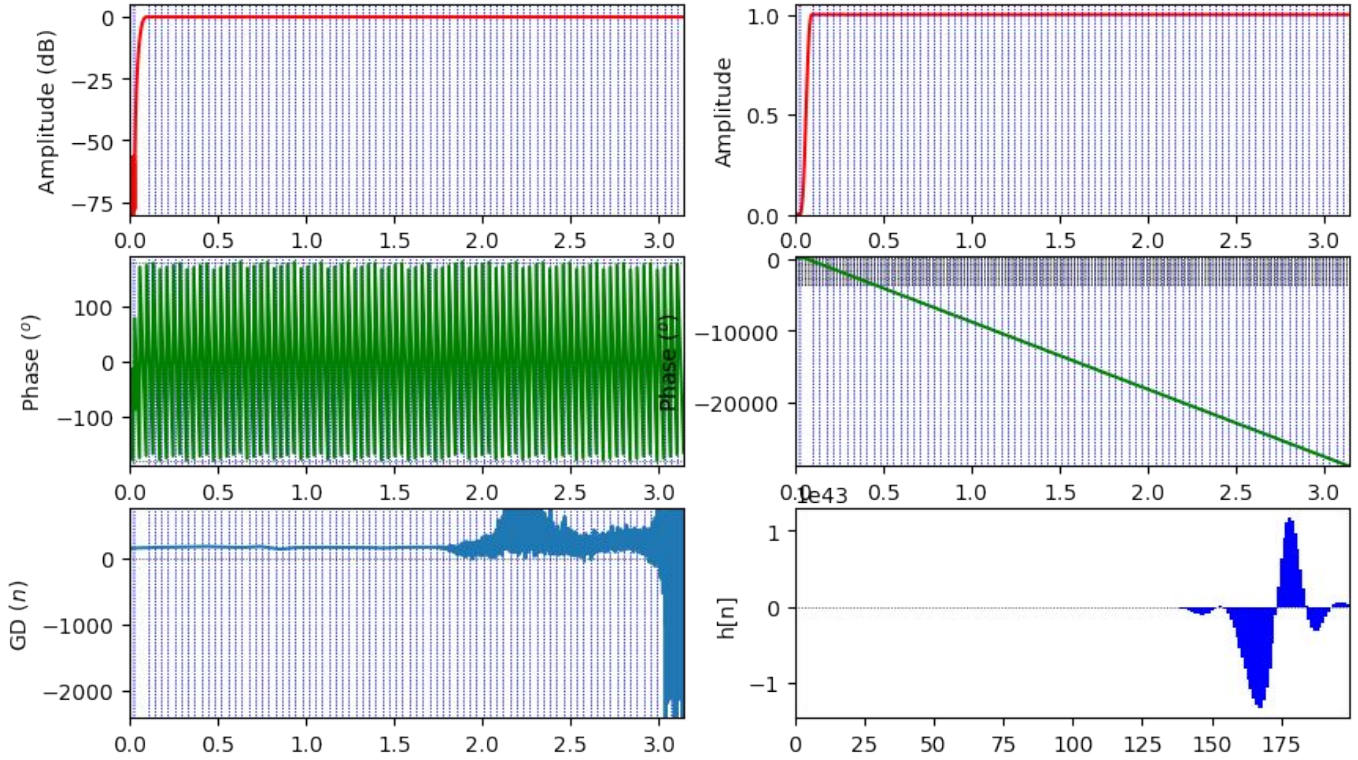
- 331 samples
- Group delay constant at 156
- Impulse delay of 180 samples



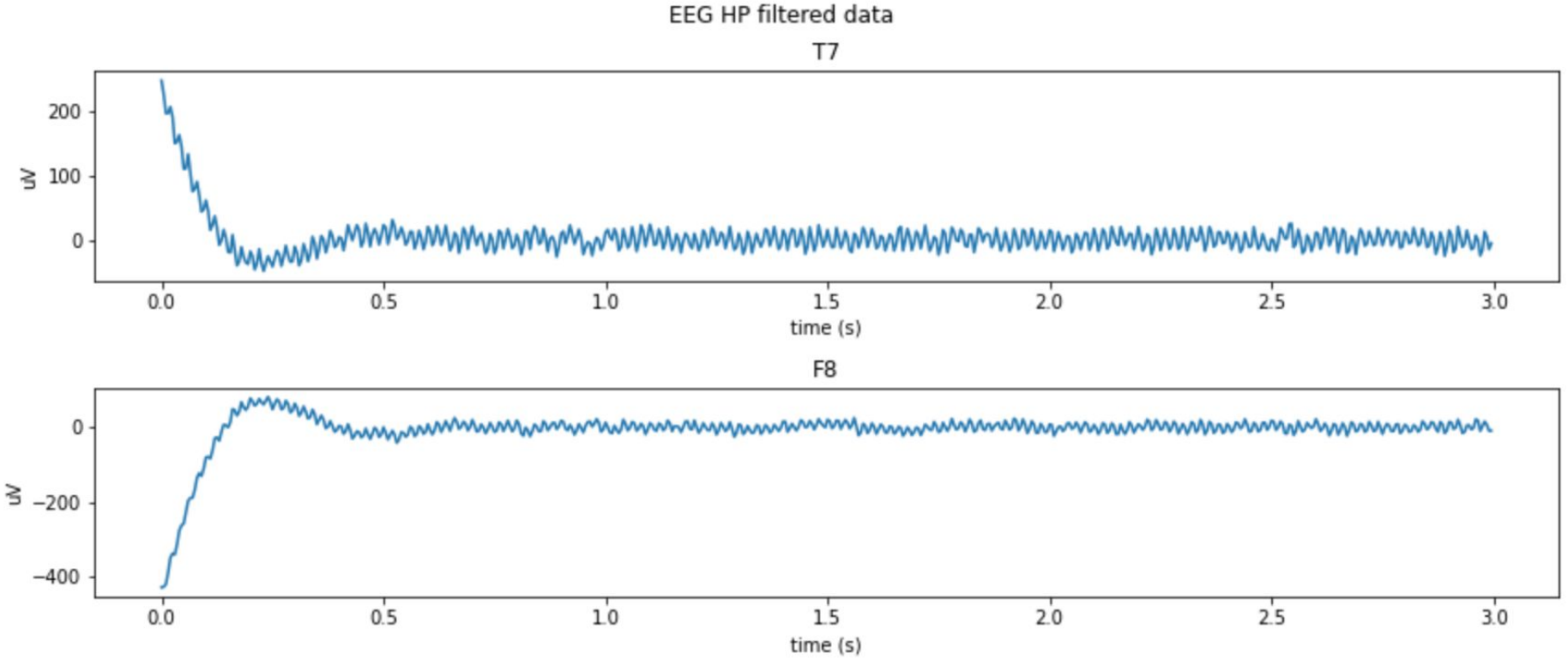


HPF pole-zero plot

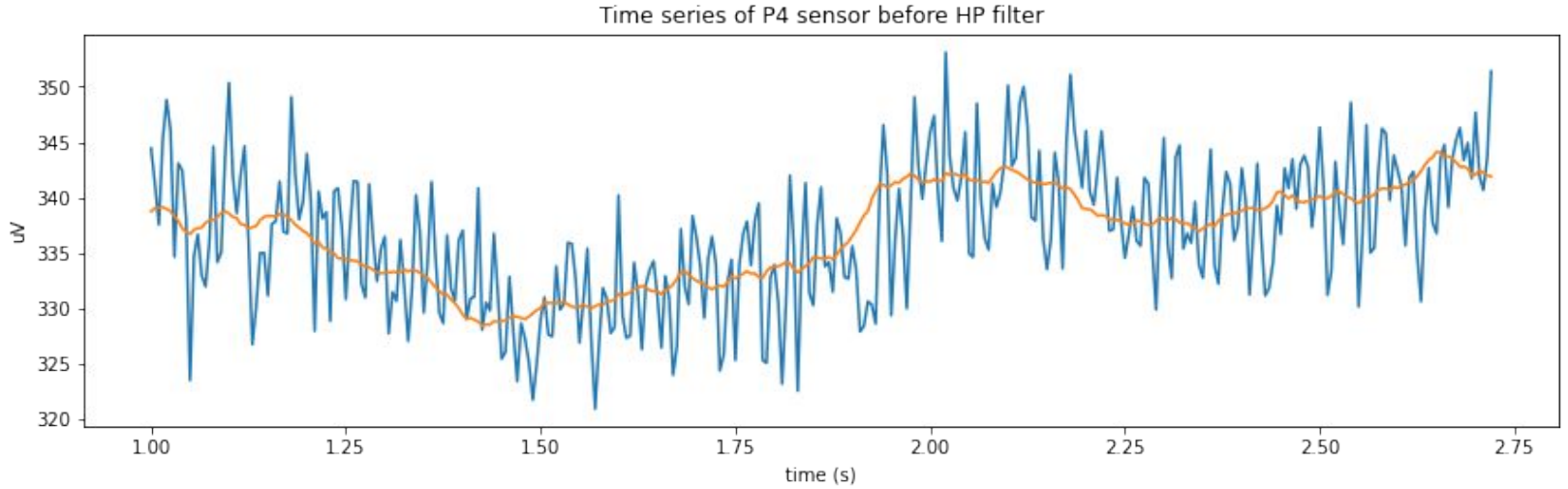
High-pass filter characteristics

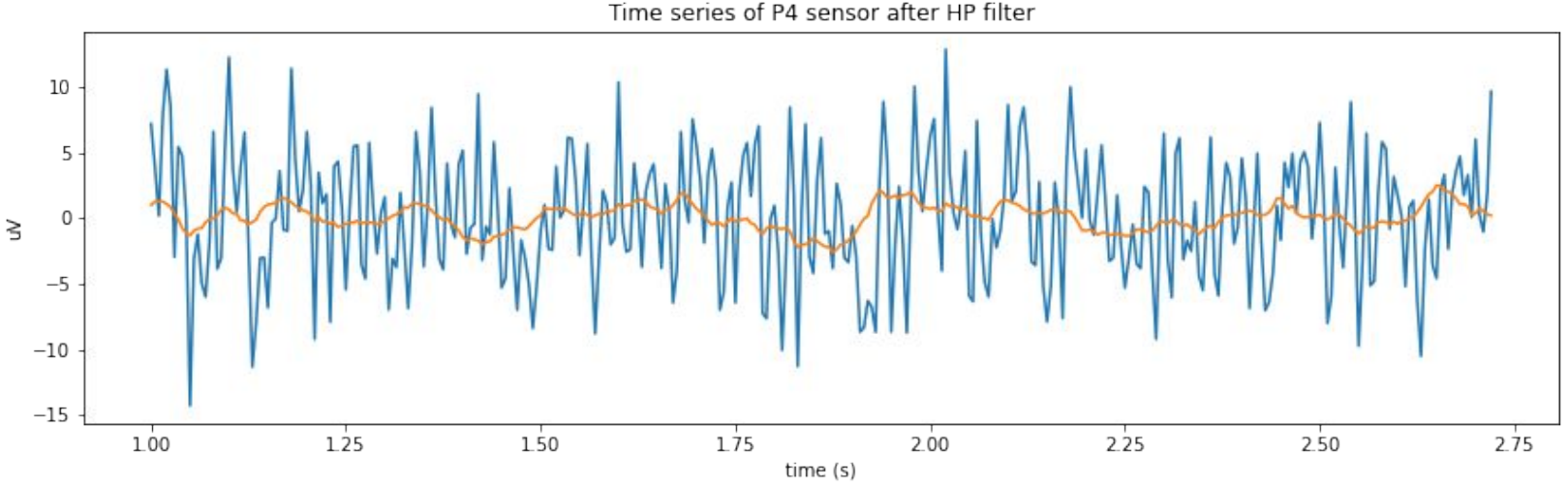


Edge effects

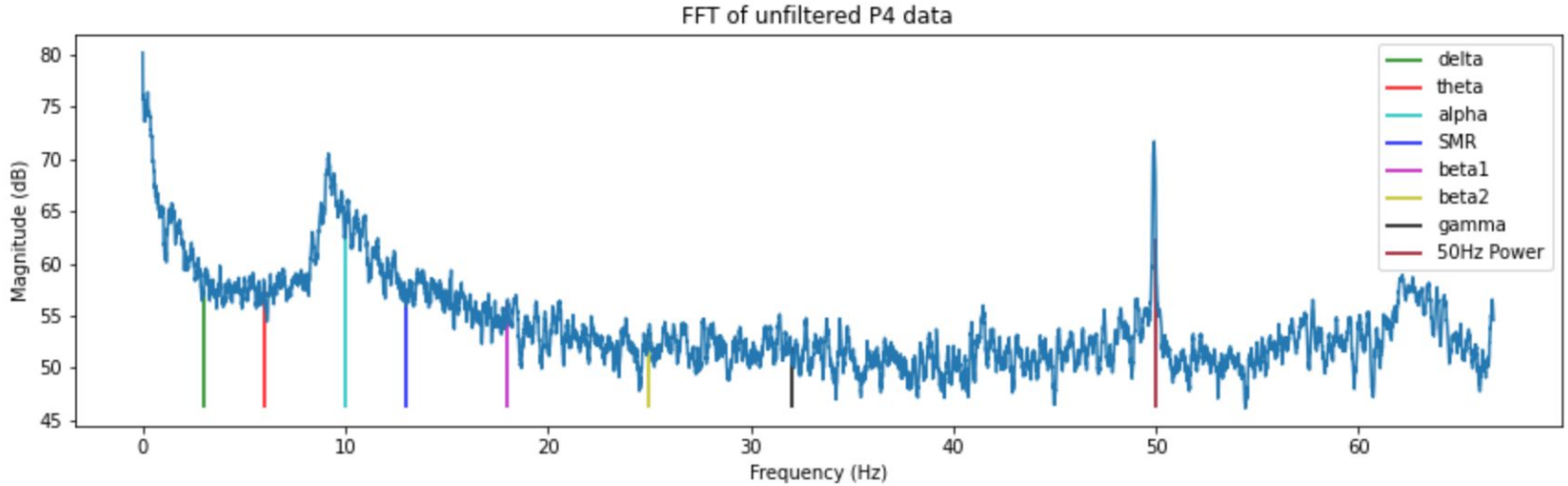


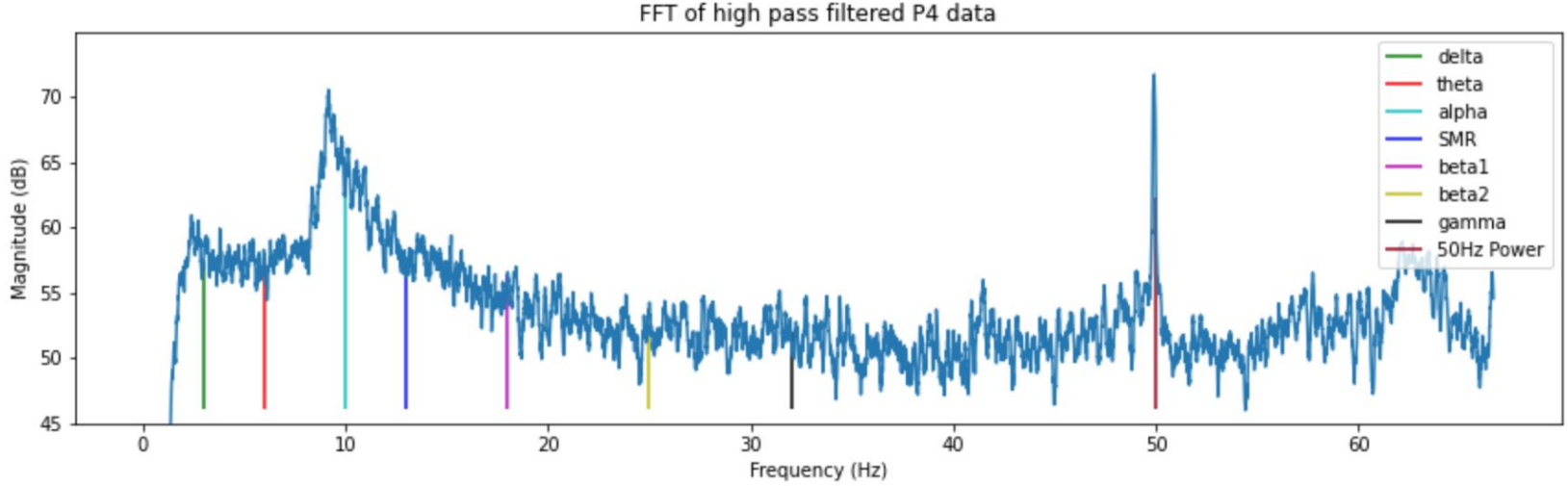
Time Series of sensor P4 before and after HPF





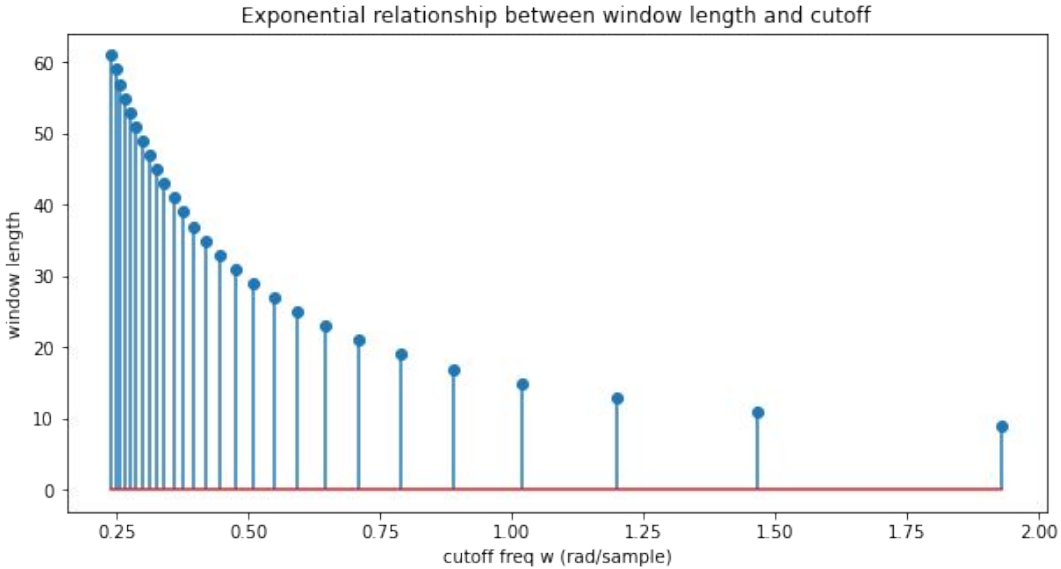
FFT of sensor P4 before and after HPF

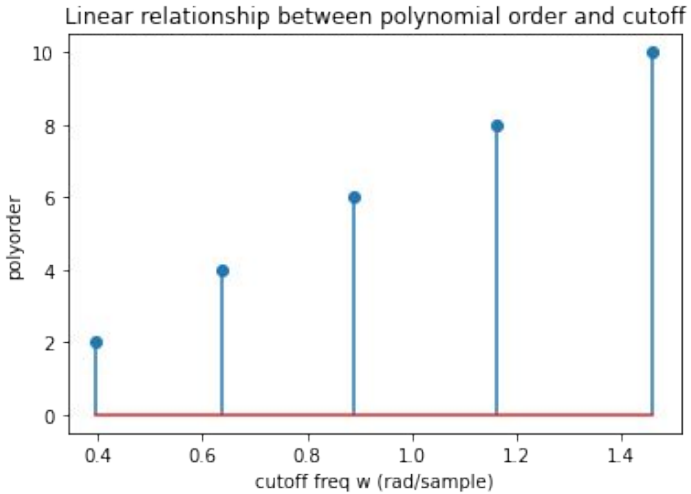




Developing a Savitzky-Golay filter

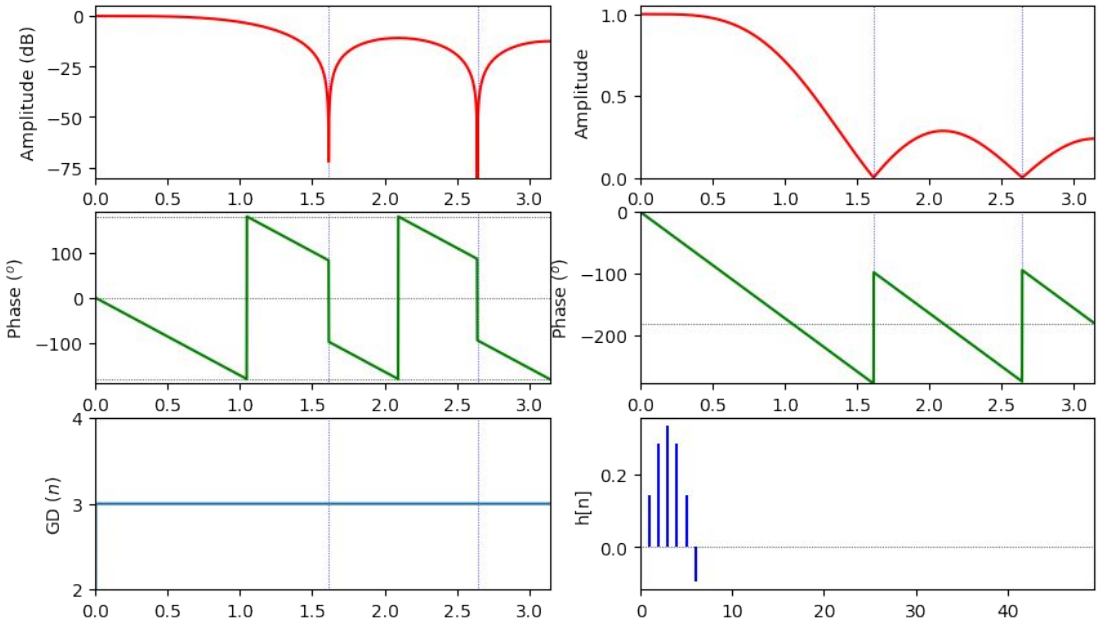
In order to design this filter so that the first zero is near the desired frequency to suppress, the window length and polynomial order must be balanced. There is not much room for design here, so this didn't turn out to be the best filter for this job.

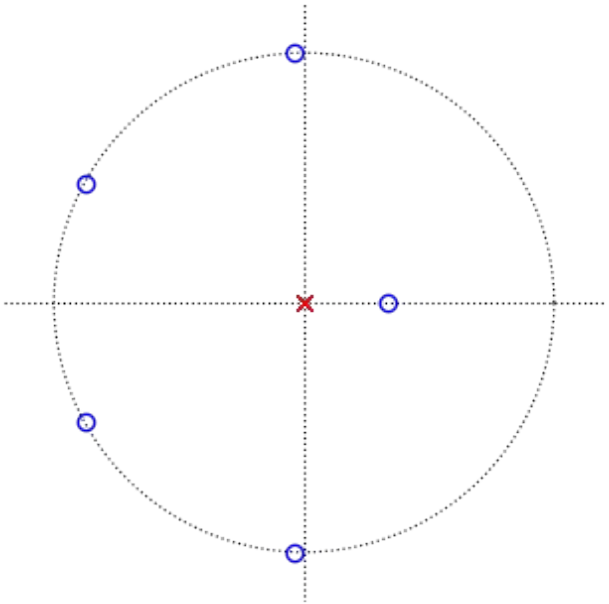


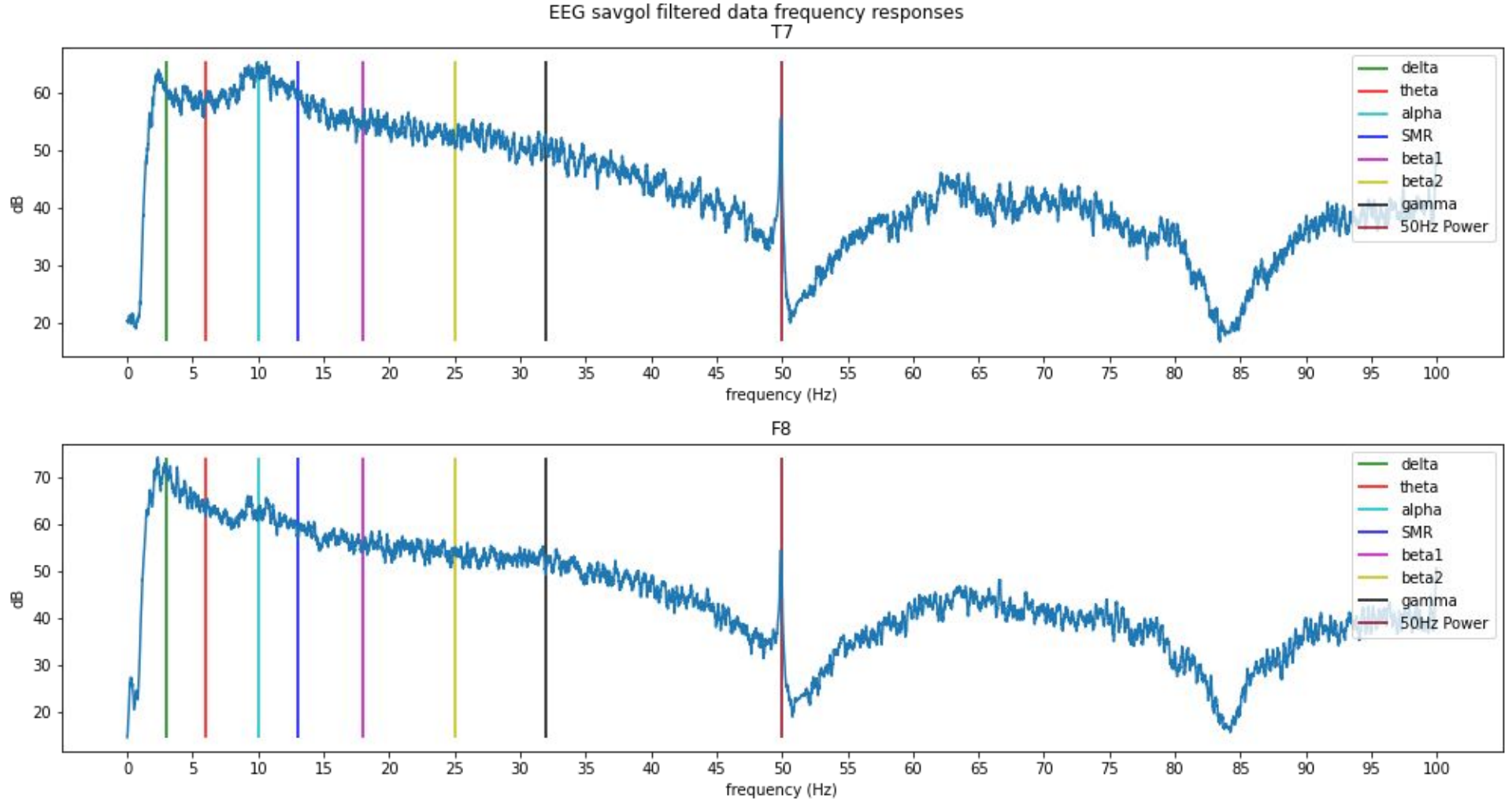


Savitzky-Golay filter specifications

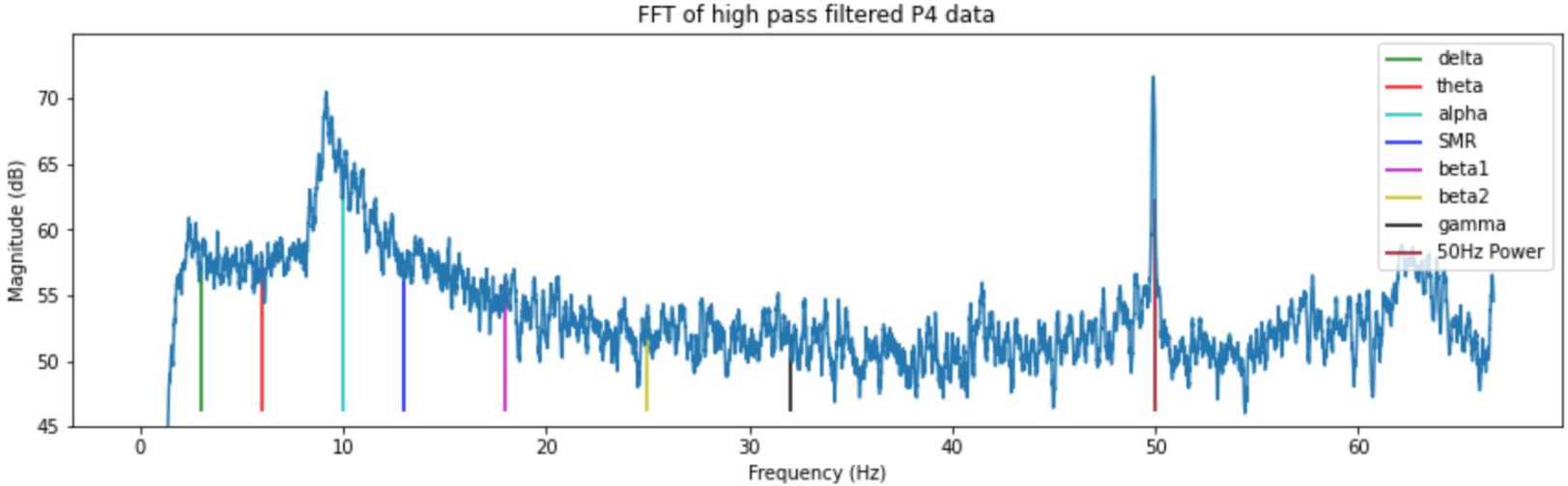
- Length of 7
- Polynomial order of 3
- No derivative element

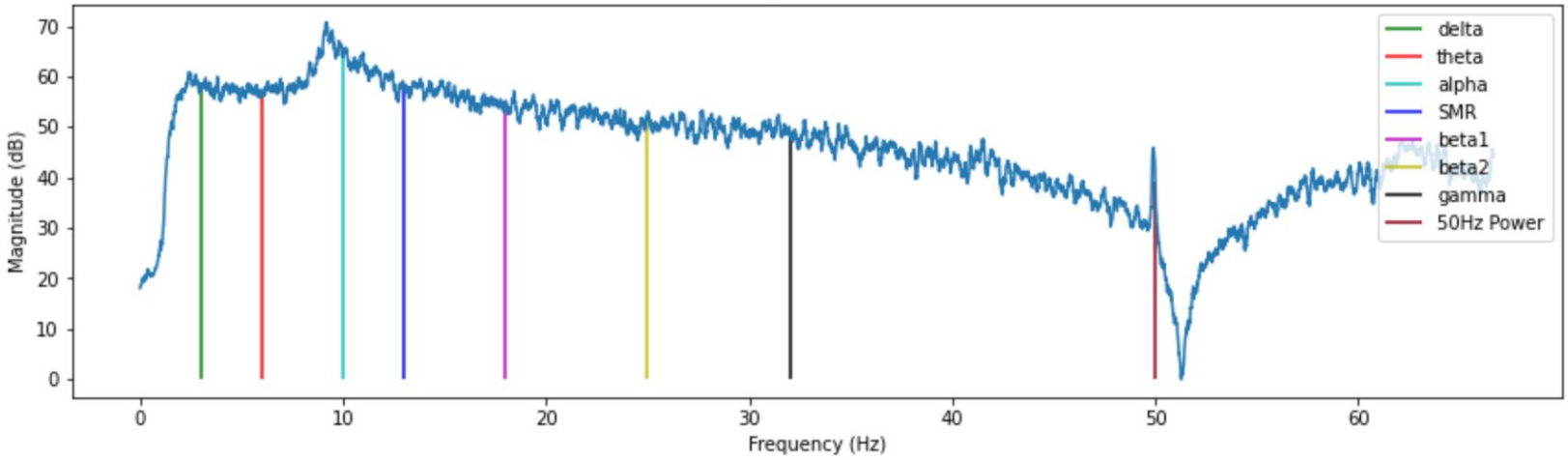




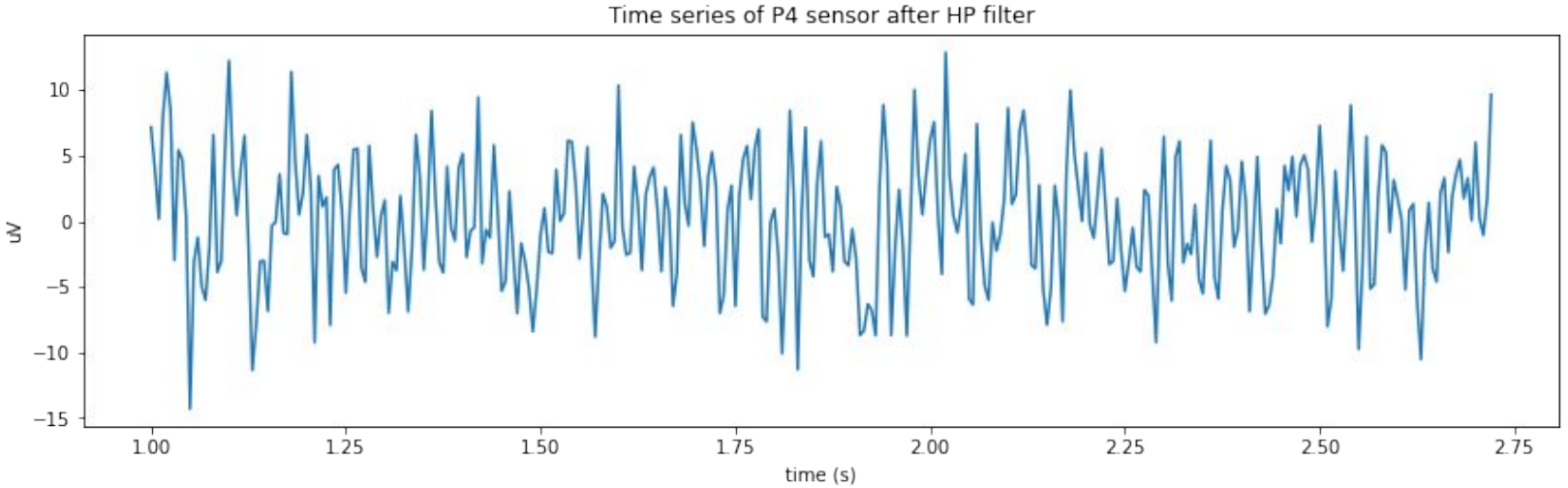

EEG savgol filtered data frequency responses
T7
dB
frequency (Hz)
delta
theta
alpha
SMR
beta1
beta2
gamma
50Hz Power
F8
dB
frequency (Hz)
delta
theta
alpha
SMR
beta1
beta2
gamma
50Hz Power

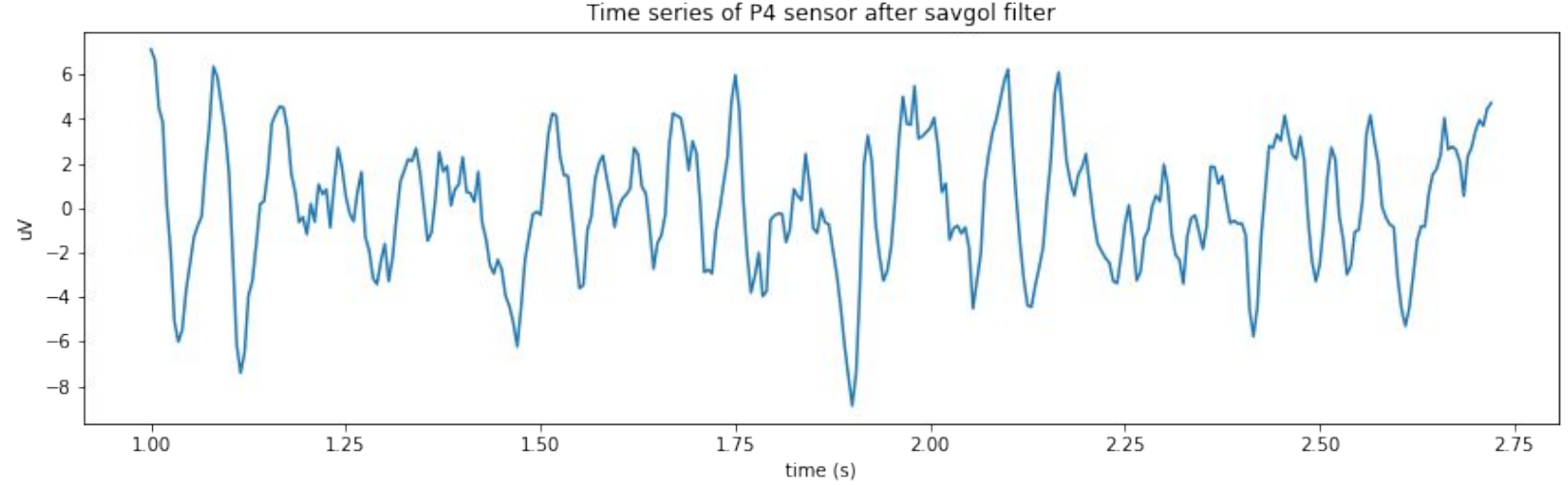
FFT of sensor P4 before and after savgol filter





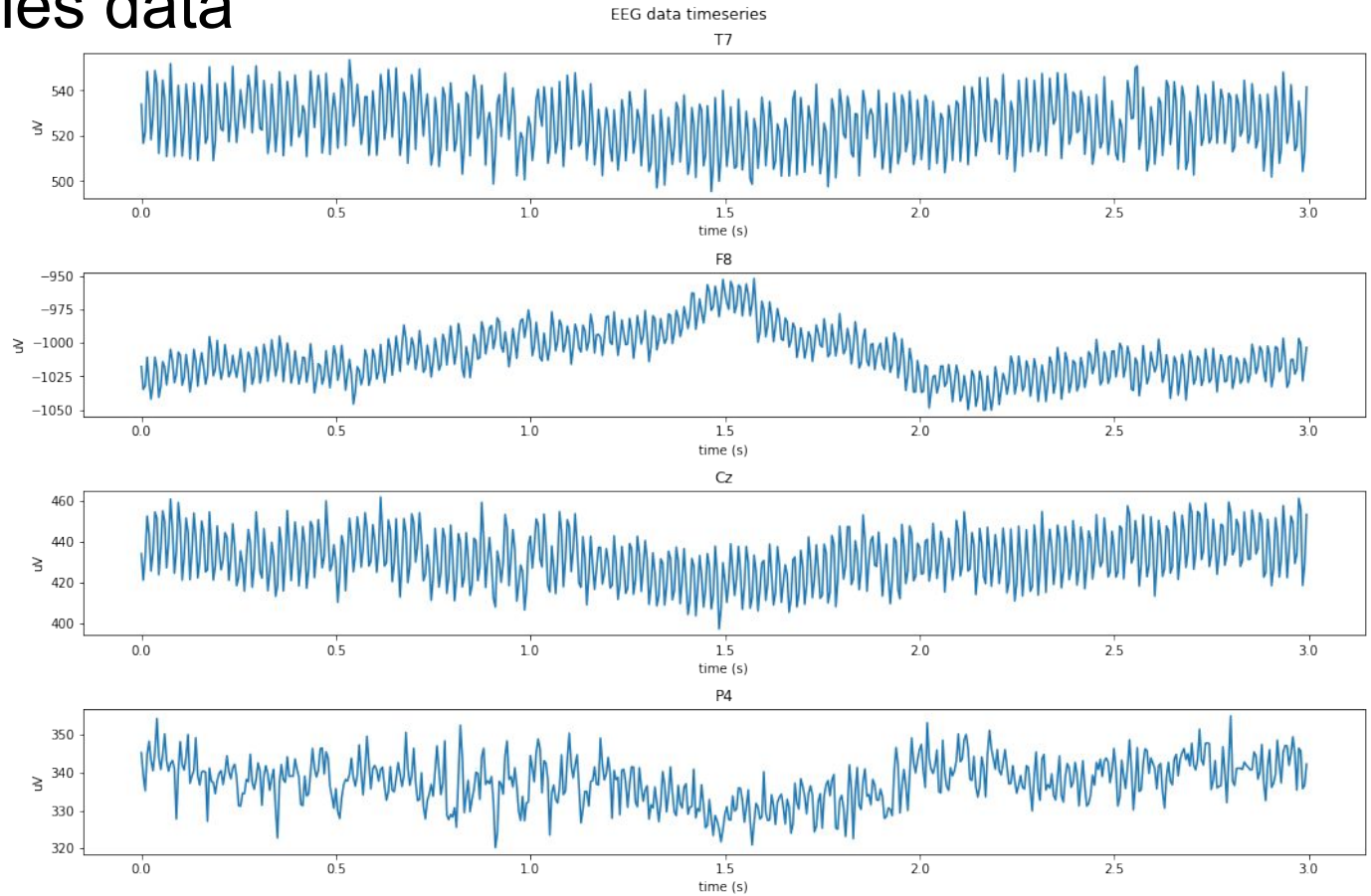
Time Series of sensor P4 after HPF and after savgol filter





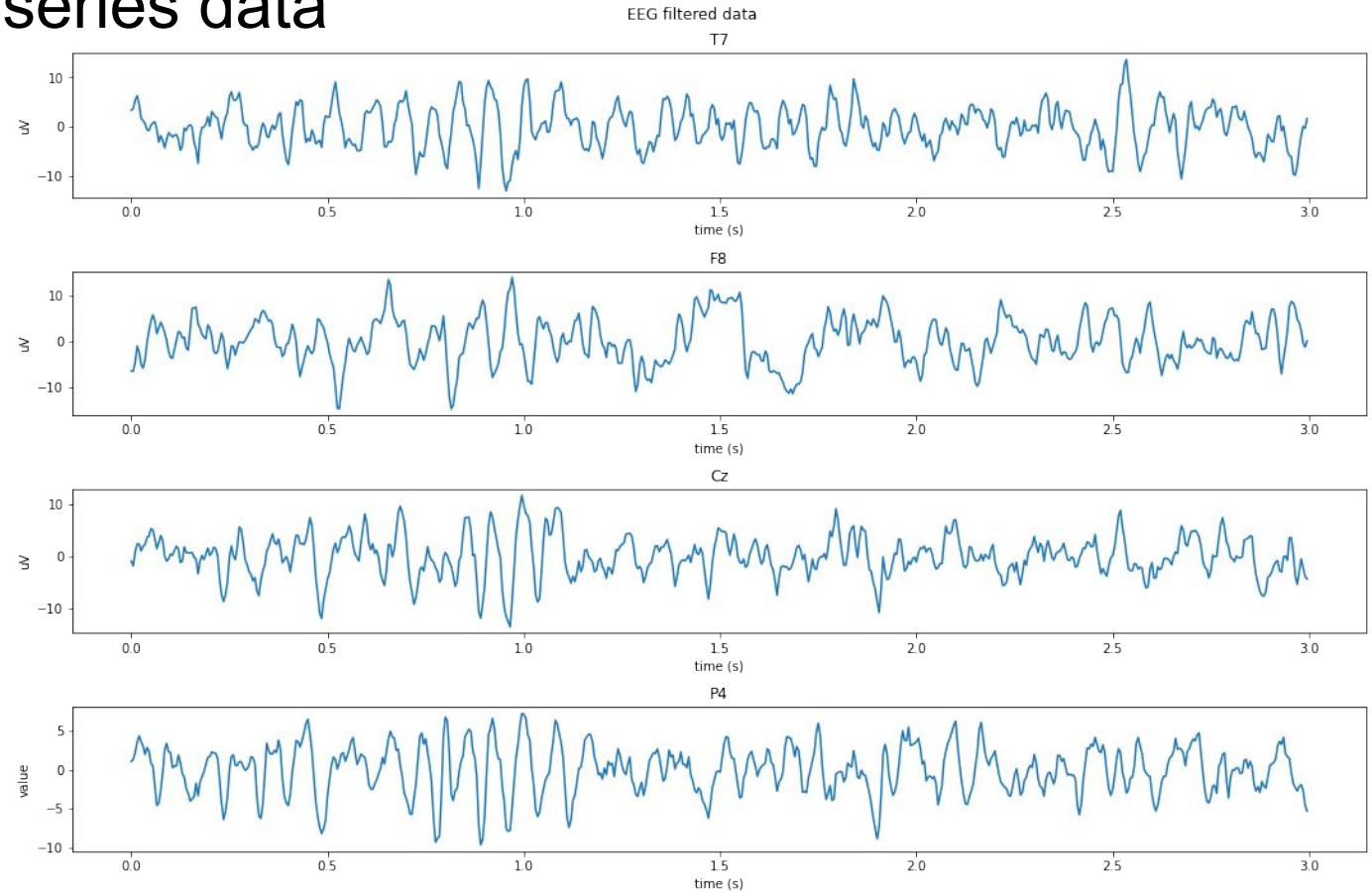
Raw time series data

Notice the units on the y-axis between this slide and the next.



Filtered time series data

The output shown here is after the application of both filters.



Citations for this presentation

- The McGill Physiology Virtual Lab. (n.d.). Recording the electrical activity of the brain from the scalp: an introduction to the acquisition of biological signals. Biomedical Signals Acquisition. Retrieved December 6, 2021, from https://www.medicine.mcgill.ca/physio/vlab/biomed_signals/eeg_n.htm.
- Garcia-Molina, Gary. (2004). Direct brain-computer communication through scalp recorded EEG signals. 10.5075/epfl-thesis-3019.