**HW7: Frequency decomposition**

You have recorded a local field potential with the following parameters:

Sampling frequency 1kHz

The vector in the attached data set includes the voltage trace of the LFP from your session, as well as timestamps, in ms, for a recurring event.

1. Plot the power spectrum of these data, including frequencies from 1 to 150 Hz (*Hint*: the spectrum will look smoother if you first divide the data into trials, or another time epochs, and plot the average. Make sure your x-axis is in Hz!). Then remove electrical noise (60Hz) and its first harmonic with a notch filter and overlay a plot of the filtered power spectrum.
2. Plot the mean event related potential (ERP) in response to the event indicated by the timestamps, working from the notch-filtered data. Use a window from -500ms before each event to 1500ms after.
3. Bandpass your signal in the following frequency ranges, and for each

(a). plot a length of the data equal to 4 seconds

(b). perform a Hilbert transform and separately plot the analytic amplitude and phases for the same length of data:

4-8 Hz (theta)

8-12 Hz (alpha)

13-30 Hz (beta)

*Hints:* There are a number of different filters that will bandpass a signal. Below is code for building a first-order finite infinite response (fir) filter in MATLAB using the function fir1.m and filtering the data with the function filtfilt.m. For the purposes of getting experience using a bandpass filter, it’s not necessary to go further in depth into building filters, however if you’re interested in more information, I suggest chapter 14 here: <https://www.dspguide.com/pdfbook.htm>

%build a filter to bandpass data between frequencies *lowf* and *highf* (in Hz)

samp\_freq = 1000; %sampling frequency in Hz

order = round(samp\_freq); %this is the size of the filter – using the sampling frequency is an easy approximate

Nyquist = floor(samp\_freq/2);

Myfilt = fir1(order,[lowf highf]./Nyquist);

%Now filter the data in the variable *sig*

filt\_lfp = filtfilt(Myfilt,1,sig);

4. Finally, plot the average response in beta frequency (the average of the analytic amplitudes) from 500ms before to 1500ms after each event.