Brain Signal Analysis and Applications (Fall 2023, BME 473/ELE 573)
Instructor: Dr. Yalda Shahriari

1st homework, 9/14/23 (The homework, is due by Sept 28th, 11:55 pm).

Instruction: Load the "sampleEEGdata" into your Matlab workspace. This EEG dataset contains 64 channels (EEG.nbchan), 640 time points (EEG.pnts), and 99 trials (EEG.trials). The time points in "ms" have been saved in EEG.times where you can see each starts at -1000 ms and ends at ~1500 ms. Use the topoplot.m function for plotting the head plots. Save the 'eloc 64C2.txt' file in the same directory as the topoplot.m function for further analysis.

a)   Extract epochs from 0 to 800 ms. Compute the event-related potentials (ERPs) at each electrode. Get the average over all the trials. Select nine time points at which to show topographical plots (e.g., 0 to 800 ms in 100ms steps). In one figure, make a series of topographical plots at these time points. To increase the signal-to-noise ratio, make each plot show the average of activity from 20 ms before until 20 ms after each time point. For example, the topographical plot from 200 ms should show average activity from 180 ms until 220 ms. Indicate the center time point in a title on each subplot.

b)   Loop through each electrode and find the peak time of the ERP between 100 and 800 ms. Store these peak times in a separate variable and then make a topographical plot of the peak times (that is, the topographical map will illustrate times in milliseconds, not activity at peak times). Include a color bar in the figure and make sure to show times in milliseconds from time 0 (not, for example, time indices instead of milliseconds). What areas of the scalp show the earliest and the latest peak responses to the stimulus within this window?

(Note: Make the colormaps in 'jet' format and keep the color limit for all the topoplots for each section the same).

For only 500 level—optional for the 400 level (extra credit):

c)   Repeat step (a) by applying large Laplacian filter. Compare step (c) with step (a) and clearly explain your observations and comments (hint: To obtain the distance and the surrounding electrodes, transfer the polar coordinates in eloc64C2.txt file into Cartesian. Then for each electrode of interest keep those electrodes that are in radius [0.18 0.28], remove the rest, continue obtaining your weights, and then obtain the Laplacian filtered signal).