COMP6620 Signal Analysis for Computing - mini project on Steady State Visual Evoked Potential (SSVEP)

SSVEP is the response of the brain when visualising flashing objects and recorded using electroencephalogram (EEG) in the visual cortex. SSVEP response will resonate at the same frequency of the flashing object that the user gazes upon. So, if a block flashes at 10 Hz, the SSVEP response would also have a frequency component at 10 Hz.

Here, the data is from one user who looked at **four** objects each flashing with a fixed integer frequency (which you will have to determine) in the range of 8 to 30 Hz. The time when user gazed at each object varied from 1, 2 or 3 seconds. User also occasionally took a break (i.e. non-gazing) for either 1, 2 or 3 seconds where EEG only recorded random noise. The total length of the EEG data **varies** from 20 to 30 seconds (in blocks of 1 second) and the sampling frequency used was 250 Hz.

SSVEP or non-gazing segments do not overlap, i.e. either the user looked at a specific block or it was a non-gazing period.

The data is also corrupted by two noise:

1. Baseline sinusoidal with frequency lower than SSVEP
2. Powerline (50 Hz) interference

Data for each student is different but all fit the above description.

Your task is to segment and label corresponding segments with either one of the determined SSVEP frequencies or non-gazing as shown in Table 1 below (***just as an example, data provided to you will be different***). Furthermore, in your report, you will also need to give details on the approaches utilised (and the justifications) with Matlab code snippets and figures as appropriate. The full set of Matlab codes (as one file) should be uploaded to the raptor folder.

In order to do this project, you will need to use the given data and complete the following tasks by writing the necessary Matlab codes:

1. Load the signal and decide the **length** of the signal (2 marks)
2. Design a **notch** filter to remove 50 Hz powerline interference (3 marks)
3. Design a high pass filter with appropriate **order** and **cut-off** to remove the baseline noise (4 marks)
4. **Segmentation** of the signal to 1 second lengths each (3 marks)
5. Design **appropriate** filter for the SSVEP data (4 marks)

6. For each segment, decide the **specific** SSVEP frequency or if it is a non-gazing period (5 marks). Note that full marks can be obtained for this task if **any** 20 segments are correctly identified (each correctly identified segment gaining 0.25 marks).
7. Decide which of the four SSVEP frequency gave the **best response** using spectral analysis methods (4 marks). Note this task requires some thought process and is not directly from the course material.

Marks for code: 25 marks. Corresponding marks for each task explanation. Total marks: 50.

Table 1

Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	ng	9	13	12	25	ng	ng	13	13	13	25	25	9	13	9	13	9	9	9	9	13	13	12	12	ng	ng	ng	9	13

You will to ensure that codes for each task can be clearly identified (for ease of marking) and include comments as appropriate. Submit only **one** Matlab script.

The report should have description of your steps and answers to tasks as above. Marks will be given based on the appropriateness/correctness of the written codes and the answers/outputs (where required). If you have questions on the data, get in touch with me or your respective class teacher.