January 10th 2025

Part II - Solutions

Q1. How many electrodes must be mounted on the subject's head?
Justify in <u>max 2 lines</u>.
Answer: 10.
Monopolar montage, 8 "active" electrodes (shown in Figure 3), 1 reference electrode ("right mastoid") and 1 ground electrode.

Q2. (a) What is the SOA of the stimulation? (b) What is the interstimulus interval? (c) What is the duration of a stimulation sequence?
State all values <u>in seconds</u> and, for (a) and (b) <u>in samples</u>.
Justify in <u>max 5 lines</u>.
Answers: **SOA: 0.5 s (128 samples)**
ISI: 0.4 s (~102 samples)
Sequence: 20 s
The ISI is given in the text as the duration of the background between stimuli (*). The SOA is obtained by summing the duration of a stimulus (100 ms) plus the ISI (*). The corresponding number of samples is obtained by multiplying by the sampling frequency, which is given in the text (256 Hz).
In a sequence, each of the 4 stimuli is presented 10 times, thus its length is $4 \cdot 10 \cdot SOA = 40 \cdot 0.5\ s$ (**)

(*) Definitions: SOA (Stimulus Onset Asynchrony) is the time interval between the onset of consecutive stimuli. ISI (Inter-Stimulus Interval) is the time interval between the offset of a stimulus and the onset following stimulus
(**) For simplicity, we have included in the sequence the background cue presented after the 40th stimulus. If justified, a different choice is also considered correct.

Q3. Are the settings of the biosignal acquisition device correct?
Justify in <u>max 3 lines</u>.
Answer: No.
The analog high-pass (antialiasing) filter has a cutoff frequency at $200\ Hz$, but it must be below the Nyquist frequency ($f_{Nyq} = \frac{f_s}{2} = 128\ Hz$).

Q4. What is the length of each feature vector?
Justify in <u>max 3 lines</u>.
Answer: 1024.
Each epoch contains 128 samples (see SOA duration in Q2). The total number of features is 8 times this value, where 8 is the number of acquired channels.

Q5. How many actuations per minute is the BCI expected to perform?
Justify in <u>max 3 lines</u>.
Answer: 3.
Since actuations occur at the end of each sequence and each sequence lasts 20s, the BCI will perform 3 actuations every 60 s.