Neuroengineering 2022-2023

Exam 14 June 2023

Solutions

Part II

A1. Given the functional connectivity networks obtained for the two sessions, as reported in **Fig. 2-A** and **Fig. 2-B:**

A1.1. Compute the **Global Efficiency** for each of the two graphs *(3 points)*

D_{PRE}=

-	∞	∞	∞	∞
1	-	∞	1	1
1	∞	-	1	1
∞	∞	∞	-	∞
1	∞	∞	1	-

$$E_{gPRE} = \frac{1}{N(N-1)} \sum_{i,j=1,i\neq j}^{N} \frac{1}{d_{ij}} = \frac{8}{20} = 0.4$$

D_{POST}=

-	3	1	2	2
1	-	2	3	3
2	2	-	1	1
2	1	3	-	1
1	1	2	3	-

$$E_{gPOST} = \frac{1}{N(N-1)} \sum_{i,j=1,i\neq j}^{N} \frac{1}{d_{ij}} = \frac{1}{20}\left(8 + \frac{7}{2} + \frac{5}{3}\right) = 0.66$$

A1.2. Comment on the results obtained at point A1.1 and indicate if the **efficiency of the communications** in the network is **changed** between the two sessions and **how**. (1 *point*)

Even if the network density is the same, as we have 8 connections both in the PRE and in the POST sessions, the organization of the network has changed after the rehabilitation. In fact, the Global Efficiency has changed from 0.4 to 0.66, indicating that the communication in the network is more efficient.

Problem

The EEG signal of an experimental subject is recorded from 32 channels, monopolar montage. The recording lasts 30 seconds and is sampled at $200\ samples/s$. The analysis necessary to interpret the neurophysiological phenomena object of the study requires that the EEG spectrum estimate has a frequency resolution of at least $0.5\ Hz$

Questions

B1. What signal processing method would you choose to comply with the specifications? *(1 point)*
(state only the name of the method)

A1: Averaged periodogram / Welch's spectral estimation

B2. Does the selected method have one or more parameter(s) to be assigned? If yes, what value would you assign to each of them? *(2 points)*
(write one parameter per line. State the name followed by the value)

A2: The spectral resolution depends on the length of the epochs on which the FFT is computed. Since a frequency resolution of 0.5 or less, the epochs should be long 2 s or more