Neuroengineering 2022-2023

July 12th 2023

Part II (old modalities)

Carefully read the following scenario and answer the questions listed below.

A **novel approach** for the **motor rehabilitation** of the upper limb is tested in a group of **post-stroke** patients.

The patients are subjected to two sessions of **neurophysiological assessment**: one immediately before (**PRE**) and one immediately after (**POST**) the rehabilitative intervention (Fig. 1). During the measurements, the patients perform a motor task involving the affected limb. To avoid fatigue in the patients, the duration of the recording is kept **short**.

Six cortical regions (3 for each hemisphere) are selected for a connectivity study of **causality in the statistical sense**. The goal is to understand if the **integration** between the **two hemispheres** (a measure known to be related to post-stroke recovery) has increased after the rehabilitation.

Fig. 1 – Temporal organization of the study

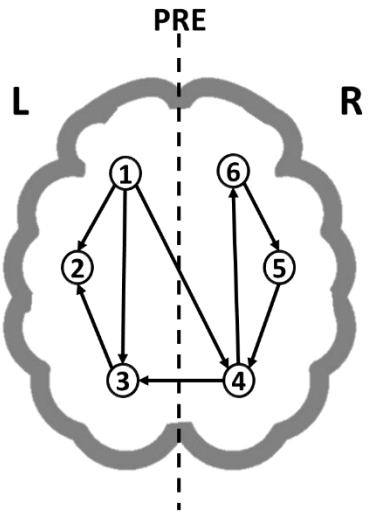

Fig. 2-A

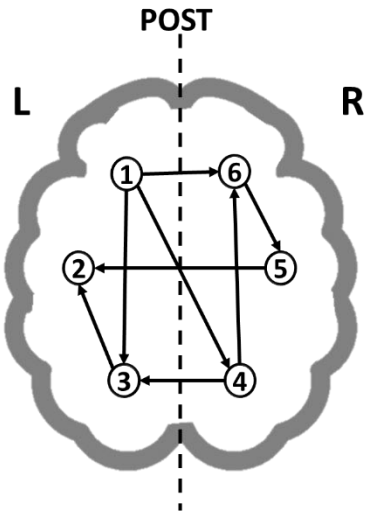

Fig. 2-B

Questions

(unless otherwise specified, write the answer in the exam.net editor)

A1. The functional connectivity networks obtained for the PRE and POST sessions are reported in **Figg. 2-A** and **2-B**. *(write the answer on paper and scan the solution)*

- **A1.1.** Extract the corresponding **adjacency matrices** *(0.5 points)*
- **A1.2.** Compute the **Density** for each graph *(0.5 points)*
- **A1.3.** Compute the **Divisibility D** and the **Modularity Q** of the network for the **PRE** session, considering the two hemispheres as classes: C=[1,1,1,2,2,2] *(2.5 points)*
- **A1.4.** Compute the **Divisibility D** and the **Modularity Q** of the network for the **POST** session, considering the two hemispheres as classes: C=[1,1,1,2,2,2] *(2.5 points)*

A2. Comment on the **changes** (POST vs PRE) in D and Q after the intervention. According to those two indices, has the integration between the two hemispheres increased after the rehabilitation, as hypothesized? *(1 point)*

A3. Indicate **which technique** for the **acquisition** of **neuroelectrical signals** you would use, and **why**. **List the pro and cons of your choice**. *(2 points)*

A4. Indicate **which connectivity estimator** you would use to perform the **network analysis**. **Justify your choice**. *(2 points)*

(end of the test)