Neuroengineering 2022-2023

July 12th 2023

Part II (A.Y. 2022/23)

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.

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.
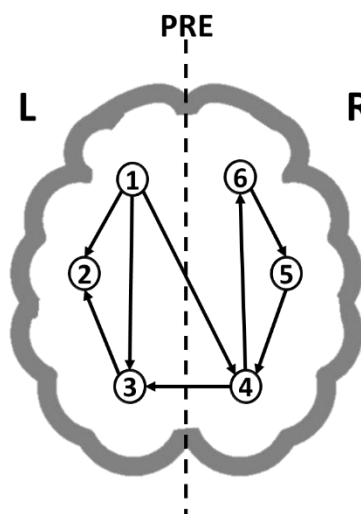

Fig. 1 – Temporal organization of the study

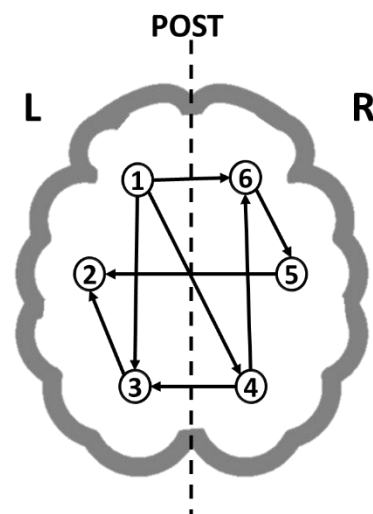
Fig. 2-A   **Fig. 2-B**

Questions

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)*