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Characterization of Visuomotor/Imaginary Movements in EEG: An Information Theory and Complex Network Approach

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Imagined activities could actually be a cognitive basis for creative thinking. However, it is still unknown how they might be related with the architecture of the brain. A recent study has proved the relevance of the imagined activity when investigating neuronal diseases by comparing variations in the neuronal activity of patients with brain diseases and healthy subjects. One important aspect of the scientific methodologies focused on neuronal diseases is therefore to provide a trustablemethodology that could allow us to distinguish between realized and imagined activities in the brain. The electroencephalogram is the result of synchronized action of the cerebrum, and our end is portraying the network dynamics through the neuronal responses when the subjects perform visuomotor and specific imaginary assignments. We use a subtle information theoretical approach accounting for the time causality of the signal and the closeness centrality of the different nodes. More specifically we perform estimations of the probability distribution of the data associated to each node using the Bandt and Pompe approach to account for the causality of the electroencephalographic signals. We calculate the Jensen-Shannon distance across different nodes, and then we quantify how fast the information flow would be through a given node to other nodes computing the closeness centrality.We performa statistical analysis to compare the closeness centrality considering the different rhythmic oscillation bands for each node taking into account imagined and visuomotor tasks. Our discoveries stress the pertinence of the alpha band while performing and distinguishing the specific imaginary or visuomotor assignments.