Ignasi Cos
Department of Mathematics and Informatics
University of Barcelona

Antonio Donaire
Institute of Neuroscience
University of Barcelona

Pathological Functional Connectivity under Epilepsy with iEEG

Movements originate from the fronto-parietal cortical loop and depend on the global mental state. However, it remains unclear how to efficiently quantify mental states in relation to movement. In particular, epileptic seizures correspond to an excess of synchrony across brain areas and are known to cause seizures. As part of the therapy for patients implanted with intra-cortical and surface electrodes we recorded sets of electro-encephalographic signals from different brain areas, under different mental states. Here we propose to test the hypothesis that the frequency of their crisis may be traced to the degree of pathological connectivity across brain areas in a quantitative fashion.

Can we distinguish different brain states from the neural data and relate them to clinical observations? Are metrics such as whole-brain functional connectivity capable of capturing this pathological state?

The project we propose aims at the following goals:

1) To assess the separability of correlation matrices in the EEG sensory space within the dataset of each individual subject, recorded under each experimental condition. Are these motivated states separable with specific machine learning techniques? (Pallarés et al., 2018).
2) If we transform the EEG signals from sensory to source space, can we identify differences in functional/effective brain connectivity as a function of state different than those typically recorded from healthy subjects?

The student's goal would be that of developing computational models of the brain, to identify and quantify differences of neural connectivity across brain areas as a function of the person's mental state. The student will also be at charge of the preparation of scientific manuscripts for publication and of presenting these results at scientific conferences.

References

Pallarés V, Insabato A, Sanjuán A, Kühn S, Mantini D, Deco G, Gilson M (2018) Extracting orthogonal subject- and condition-specific signatures from fMRI data using whole-brain effective connectivity. Neuroimage 178: 238-254; doi: 10.1016/j.neuroimage.2018.04.070