Grenoble Institut Neurosciences

Post-doc proposal

fMRI in animal models of brain state transitions

Context

This postdoc position is sponsored by two projects: the Human Brain Project and an ANR-NSF grant, Q-Func.

The Q-Func project, Advanced Spatiotemporal Statistical Models for Quantification and Estimation of Functional Connectivity, is funded by a joint NSF-ANR grant between Grenoble (France) and Santa Barbara (USA). Q-Func is gathering statisticians (Department of statistics, UCSB, Statify, LJK, Univ. Grenoble Alpes), machine learning (Lausanne University) and neuroimaging (Grenoble Institut Neurosciences, Univ. Grenoble Alpes/Inserm) experts to develop methods for robust and statistically consistent estimation of networks using functional data analysis for multivariate data sets such as those observed in neuroimaging. This project is developed in the context of the Grenoble Artificial Intelligence Institute MIAI (https://miai.univ-grenoble-alpes.fr/). 2 PhD students are already working within the project.

During this post-doc project, we will rely on data collected in the context of the Human Brain Project (www.humanbrainproject.eu) and more specifically in the Task "Multiscale models of brain responsiveness: from single cells to the whole brain" of WP2 "Networks underlying brain cognition and consciousness" of HBP. The main objective of this Task is to model the responsiveness and large-scale spatiotemporal spread of information in different brain states in humans, using integration of experimental data and computational models during brain state transitions. To test and optimize brain models already developed in HBP, several animal and human experiments are conducted. This Task is developed in close partnership with Paris-Saclay Institute of Neuroscience (Alain Destexhe, neuro-psi.cnrs.fr), who develops brain models aiming at reproducing both EEG and fMRI features.

Here, we will therefore exploit some of the data already collected for HBP to evaluate the new statistical methods developed in the Q-Func project.

Roadmap

At the Grenoble Institute of Neuroscience, we investigate brain responsiveness in rodents using sensory stimuli and resting state activity, under different brain states. The current fMRI and scalp EEG set-up allows the acquisition of data in rats during resting state and following sensory stimulus (e.g. whiskers deflection, visual stimulation). A first data analysis pipeline for processing resting state data is available (2). Data are acquired at 9.4T, at IRMaGe facility (https://irmage.univ-grenoble-alpes.fr)

The following roadmap is proposed for the post-doc:

- **(i)** Participate to data acquisition in mice, under different anesthesia, with the help of a biologist and a Ph.D. student with a background in MRI.
- **(ii)** Evaluate new methods to compare resting-state brain networks, using existing data fMRI/EEG data obtained in rodents under different physiological conditions. We will compare classical approaches such as ICA and graphs and evaluate machine learning approaches to classify graphs and detect functional anomalies.
- **(iii)** Evaluate new methods to characterize the dynamic of a resting state network using existing data collected in an epilepsy rat model (the GAERS rat, Genetic Absence Epilepsy Rat from Strasbourg (1)). We will evaluate the ability of graph approaches to robustly track brain state changes, especially when these changes occur frequently.

The successful candidate should have a Ph.D. in neuroscience / applied mathematics or related field, and a strong interest for image and signal processing. Experience in preclinical studies and/or MRI or EEG data processing will be appreciated.

Contact: send CV and motivation letter before the 30th of September to Emmanuel Barbier (emmanuel.barbier@univ-grenoble-alpes.fr), Olivier David (olivier.david@inserm.fr), and Sophie Achard (sophie.achard@univ-grenoble-alpes.fr)

Location: Grenoble Institute Neurosciences, https://neurosciences.univ-grenoble-alpes.fr

Start date: Fall 2021 – Contract duration: 1 year, renewable once.

Références:

(1) *Depaulis A, David O and Charpier S (2016). The genetic absence epilepsy rat from Strasbourg as a model to decipher the neuronal and network mechanisms of generalized idiopathic epilepsies. J Neurosci. Methods 260, 159-174*

(2) *G. J.-P. C. Becq, T. Habet, N. Collomb, M. Faucher, C. Delon-Martin, V. Coizet, S. Achard, E. L. Barbier. Functional connectivity is preserved but reorganized across several anesthetic regimes. Neuroimage, 2020.*