Proposal of Master Research Project / Trabajo fin de Master for the academic year 2022-23

Group name: **Development, plasticity and regeneration of thalamocortical circuits**
IP name: **Guillermina López-Bendito**
Group web: **http://lopezbenditolab.com/**

Title of the MRP/TFM:

Evaluation of a new analysis method for exploring the construction of the cortical circuits during development.

Summary of the Project:

During cortical development, patterns of activity emerge spontaneously and play a pivotal role in the organization of the circuits. Activity influences circuit formation by coordinating firing between pre- and post-synaptic neurons. Studying the nature of the local interactions during development can be very productive for understanding the formation and function of cortical circuits. For this purpose, the use of field potentials (FPs) could be a promising avenue given that this biological signal reflects synaptic activity onto thousands of neurons around each recording contact. However, the main caveat of FPs is that in general this bio signal is a superposition of contributions from many underlying neural populations. This makes interpretation of FPs measurements in terms of the underlying neural activity challenging. Classical statistical analyses of FPs rely on two-dimensional matrix (space, time) decomposition-based methods for disentangling the contribution from different neural populations. Although these have proved to be useful, their use remains limited due to the strong mathematical assumptions they impose on the data. Recently a new approach to FP decomposition by considering three-way data (trial, space, time) arranged as third-order tensors has been proposed. Unlike classical methods, this decomposition does not impose strong assumptions into FP and has proved useful in terms of finding underlying patterns in complex datasets in many domains including social network analysis, chemometrics, signal processing and neuroscience.

In this project, we propose to evaluate for the first time the performance of tensor decompositions in real intracranial FP signals recorded in perinatal mice. The aims of this project for the students are: (1) become familiar with the technique for recording extracellular potentials (FPs) in vivo; (2) helping to implement the new tensor-decomposition method and using it to analyse FPs datasets, comparing it to classical methods.

Due to the nature of the project, it is recommended a strong motivation for analysis tasks and some basic coding experience, though the last one is expected to be acquired during the course.

Methods and technology involved in the MRP/TFM Project:

In vivo recording of field potentials in mice using linear arrays of microelectrodes.
In vivo electrical brain stimulation in mice using microelectrodes.
Basic histological techniques.
Analysis of neural time series (MATLAB, Python)

Member/s of the lab who will act as tutor/co-tutor of the project (if different from the group IP): Dr. Dorien Vandael, Dr. Daniel Torres Romero

Contact: dvandael@umh.es, dtorres@umh.es, g.lbendito@umh.es