Master de Sciences et Technologies
Mention Biologie Intégrative et Physiologie
Parcours : Neurosciences
Responsable : Professeur Régis Lambert

Internship Proposal
Academic Year 2018-2019

1. Host team:

Research Unit (e.g. Department or Institute): **Unit of Neuroscience Information and Complexity (UNIC)**
Research Unit Director: **Daniel Shulz**
Research Team Director: **Daniel Shulz**
Team name: **Neural Processing, Neuromodulation and sensory plasticity**

Address: **UNIC FRE 3693, Bât. 32/33,1 avenue de la Terrasse, 91198 Gif sur Yvette**

Supervisor of the Research Intern for this project: **Isabelle Ferezou**
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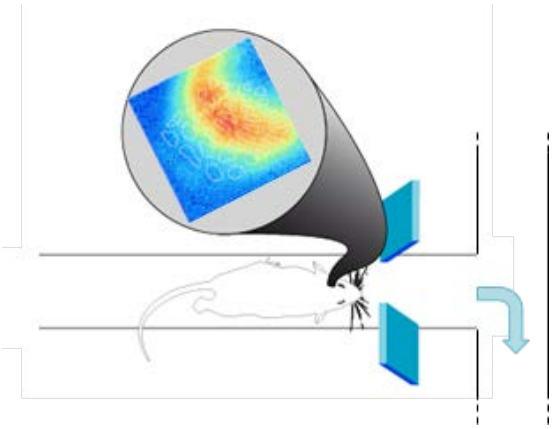
2. Internship project title:

Fribroscopy for large scale imaging of cortical dynamics during active sensing in freely behaving mice.



3. Internship Description:

The team is specialized in integrative neuroscience, using the tactile somatosensory pathway from whiskers to cortex in rodents as model system. Our research is centered on the study of neuronal processes responsible for the coding of tactile sensory information and perception, as well as their regulation through the interaction of the animal with the environment.

By means of electrophysiology and functional imaging in anesthetized rats and mice, we have shown that the primary somatosensory cortex can extract emergent properties of a complex multiwhisker tactile stimulation, such as the global direction of a multiwhisker stimulus generating an apparent motion across the whiskerpad (Jacob et al., 2008, Vilarchao et al., *in press*). To understand the involvement of such integration mechanisms and their perceptual and behavioral importance, it is essential to study them in the awake animal.

Our objective is therefore to link the recording of cortical dynamics and the animal's behavior in an experimental paradigm involving the extraction of global properties of an object by the animal.

Nowadays, neurophysiologists generally address this type of questions by working with awake "head-fixed" mice, in other words with animals that have been accustomed to be held by the head (with implants fixed on the skull) under conventional optics. It is indeed possible, in this configuration, to train animals to perform simple behavioral tasks, while imaging large assemblies of neurons. These experiments, however, remain highly restrictive and limit the behavioral repertoire that can be studied.

On the contrary, we aim to work with freely moving animals in conditions allowing the development of an operant conditioning task where the mice have to extract the global properties of an object through the use of their whiskers.

We propose here to lay the groundwork for this ambitious project by developing in the laboratory a method of fibroscopy allowing to study the cortical dynamics during the task at the mesoscopic scale (with a field of view covering the cortical representation of all the macrovibrissae within the primary somatosensory cortex). This will be made possible by using voltage sensitive dye imaging, which offers excellent spatial and temporal resolution, through a fiber bundle interface, which provides sufficient flexibility and lightweight properties to disrupt minimally the behavior of the animal without sacrificing the optical qualities of imaging system (Ferezou et al., 2006).

The validation of this experimental approach is a key step, essential to the study of cortical dynamics associated with cortical processing of multi-whisker stimuli during a tactile discrimination task that we wish to develop in the laboratory with the aim of deciphering the cortical dynamics governing the extraction of global properties of an object from complex sequences of multivibrissal contacts.

Jacob V, Le Cam J, Ego-Stengel V, Shulz DE. Emergent properties of tactile scenes selectively activate barrel cortex neurons. Neuron. 2008 Dec 26;60(6):1112-25.

Vilarchao ME, Estebanez L, Shulz DE, Férézou I. Supra-barrel distribution of directional tuning for global motion in the mouse somatosensory cortex. Cell Reports. 2018. *In press*.

Ferezou I, Bolea S, Petersen CC. Visualizing the cortical representation of whisker touch: voltage-sensitive dye imaging in freely moving mice. Neuron. 2006 May 18;50(4):617-29.