Operant conditioning of cortical neural discharge for control of a prosthetic device

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Internship proposal for : Master 1 or Master 2

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Subjects

1.: Brain Machine Interface
2.: Motor and somatosensory systems
3.: Neuronal coding

Tools and methodologies

1.: Electrophysiology
2.: Operant conditioning

Summary of lab's interests

Using the barrel cortex of the rat as a system model, our research is centered on the study of neuronal processes responsible for the coding of sensory information and perception, as well as their regulation through the interaction of the animal with the environment. We are interested in the propagation and integration of neuronal information in the primary somatosensory cortex and the emergence of collective properties in response to spatially distributed stimuli on the receptor surface. In addition, we study the functional and synaptic adaptation described by Hebbian and non-Hebbian plasticity algorithms. We include in this research, the study of permissive factors linked to the attentional and behavioral state of the animal which are mediated by ascending neuromodulatory systems. For more information see : http://www.unic.cnrs-gif.fr/teams/Research group of Daniel Shulz

Summary of project

The scientific aim of this research is to develop brain-machine interfaces in rats that could be eventually adapted to human neuroprosthetics. Our electrophysiological work in the behaving animal is focused on an operant conditioning of behaviour made contingent of the activity of a few recorded neurons. The goal is to assess how the conditioning of small ensembles of cortical neurons may be used to create new representations of motor commands through the induction of functional plasticity. If time allows, this study will include the engineering of a biofeedback loop involving primary sensory cortical area(s), to increase behavioural performances in predefined sensorimotor tasks, but also to determine if the

processing in sensory cortex can be conditioned as well. We will use chronic recordings of small neuronal assemblies through microwire arrays in cortical areas of the behaving rat. The long-term objective is to develop the control of cybernetic limbs in humans.