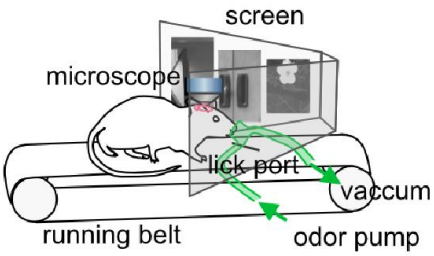
Master Project: inter-areal cortical communication underlying visual memory

This project aims to establish a visual virtual reality environment for mice, collect preliminary data from simultaneous population neural activity across areas in the mouse neocortex, and explore the inter-areal interaction dynamics between brain areas.

Background

Much evidence has shown that long-term memory is stored in the neocortex. For complex memory, each of its aspect is assumed to be stored in distributed regions. For example, the memory of visual details is shown to be stored in visual cortex, while the contextual selection of memory recall is dependent on the retrosplenial cortex. Consolidation of memory requires coordinated functional changes in the local circuits across multiple brain areas. In this project, we will set out to establish a behavior paradigm to study such memory consolidation process, and explore the preliminary datasets.



Goals

Multiple sub-projects are available in this project:
(1) Building a visual virtual reality environment: we will start by building a visual virtual reality environment with a contextual component, controlled by different odors presented to mice. In this environment, mice will be head-fixed and presented with a virtual-reality corridor, where image sequences are shown on both sides of the virtual walls. Two distinct contexts will be defined by the presence of two different odors. Such an environment will allow mice to gradually form specific visual memories that are linked to different contexts (odors) over time.

(2) In vivo experiments with awake mice: using this environment, we will aim to obtain preliminary data from the activity of neuronal populations in visual areas as well as retrosplenial cortex. This will be done using a custom-built multi-area two-photon microscope in our group.

(3) Exploration of analysis methods: we will also explore analysis techniques for understanding inter-areal communication in simultaneously recorded brain areas during behavior, from previously collected datasets. In particular, we will explore the most recent state-space models that have been developed for analyzing multi-area activity data, and test these models with real data.

You will have the option to work on the sub-project that you're most interested in.

Your profile

- Experience or interested in hardware (NI-DAQ/Labview)
- Programming experience (Python/Matlab).
- Interested in neural computation.

Supervision

This project will be supervised Dr. Shuting Han, a SNSF Ambizione junior group leader hosted within the lab of Prof. Fritjof Helmchen.

Contact

Interested students should sent an e-mail to han@hifo.uzh.ch. Please attach a brief statement explaining your background/broad interests, and a copy of your CV.