

Electrophysiological analysis of cortico-hippocampal interactions during memory consolidation.

Our lab has acquired hours-long tetrode recordings of the cortex and hippocampus for different behavioural tasks (Objects Space and Hexmaze) as well as learning conditions which we can analyse to clarify the interaction between the cortex and the hippocampus with respect to different types of high frequency oscillations. We are also interested in investigating the activity of cell assemblies which are replayed during sleep and shed light on their interaction with high frequency events.

Based on the student's interests and coding experience the internship can focus on three main types of analyses with the possibility of combining them. Examples of tasks that each analysis would require are given below. Due to the great variety of projects, we have **multiple openings** available for students.

- Analysis of sleep stages.
Computing the bout durations of sleep stages (Wake, NREM, REM, intermediate) and their transitions to compare sleep between experimental conditions. Another possibility is working on the automatic classification of sleep stages and human-like sleep stages from recordings during sleep and anesthesia.
- Analysis of Local Field Potential (LFP) signals.
This analysis involves the detection of high frequency events in cortex and hippocampus, identification of their types, amounts, co-occurrence as well as use of the Fieldtrip toolbox to describe their temporal and spectral characteristics and interactions.
- Analysis of individual spiking cells activities.
Detection of spiking activity and sorting it into individual neurons. Classification of neuron types (pyramidal and interneurons), computation and comparison of cells firing rates. Identification of cell assemblies during behaviour and their replay during sleep. Synchronization of single-cell activity with video recordings.

The analyses above can be performed in MATLAB and/or Python. We accept students with different levels of experience writing scripts. Students with little experience but high motivation are also encouraged to apply and can be considered for projects where they run previously written scripts while they increase their experience programming.

For examples of our MATLAB and Python scripts please visit:

https://github.com/genzellab/Fast_and_slow_hfos

<https://github.com/Aleman-Z/spikesorting>

For more information and if you are interested on applying please send an email with a short description of your background to **I.genzel@donders.ru.nl**.

.Relevant literature

- Aleman-Zapata A, Morris RGM, Genzel L. Fast and slow cortical high frequency oscillations for cortico-cortical and cortico-hippocampal network consolidation during NonREM sleep. bioRxiv 765149; doi: <https://doi.org/10.1101/765149>
- Genzel L, Schut E, Schröder T, Eichler R, Khamassi M, Gomez A, Navarro Lobato I, Battaglia F. The object space task shows cumulative memory expression in both mice and rats. PLoS Biol. 2019 Jun 17;17(6):e3000322. doi: 10.1371/journal.pbio.3000322.
- Khodagholy, D., Gelinas, J.N. and Buzsáki, G., 2017. Learning-enhanced coupling between ripple oscillations in association cortices and hippocampus. Science, 358(6361), pp.369-372.

Website

<https://www.genzellab.com/#/electrophysiology/>

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