



Thesis Project Form

Title (tentative): Extracting functional connectivity maps from in vivo networks

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Description

Motivation and application domain

Cortical neuronal assemblies have synchronous and oscillatory patterns of activity, the frequencies and temporal dynamics of which are associated with distinctive cognitive and behavioral states. Although the function of these patterns is still under investigation, recent experimental and theoretical results indicate that the dynamics of these forms of correlated fluctuations might be important for extracting the functional connectivity of cortical circuits and for regulating higher cortical processes that control the flow of information in the brain.

A popular analytical tool used by neuroscientists to study the joint activity of neurons is the cross-correlation histogram or cross-correlogram (Knox, 1981). Even if the cross-correlogram computation is a widely accepted technique, there are lots of differences in its implementation and it is still not clear what are the most useful methods with respect to the specific experimental condition. This Thesis aims at filling this technological and behavioral gap.

General objectives and main activities

Different algorithms for the computation of functional connectivity (FC) and the extraction of the related metrics will be selected starting from the most recent (and more adopted) literature in the field. A pipeline for the computation of the algorithms will be developed and a groundtruth generated. A performance evaluation to identify the best algorithms will be conducted, under different conditions (e.g. noise level). The student will be then responsible of testing in vivo data preprocessed by using NigeLab by means of the developed algorithms.

Training Objectives (technical/analytical tools, experimental methodologies)

The thesis will allow training in neuroscience, neuroengineering, signal processing, neural data analysis, in vivo experiments.

Place(s) where the thesis work will be carried out: DIBRIS, UNIGE, Genova, Italy

Additional information

Pre-requisite abilities/skills: Coding expertise is mandatory.

Maximum number of students: 1