UNIVERSITY OF GENOA
DEPARTMENT OF INFORMATICS, BIOENGINEERING, ROBOTICS AND SYSTEMS ENGINEERING
MASTER'S PROGRAM IN BIOENGINEERING

Thesis Project Form

Title (tentative): Characterization of sleep-wake cycle spectral state maps in healthy and pathological experimental conditions

Thesis advisor(s): Chiappalone Michela, Vinicius R. Cota (IIT; Vinicius.RosaCota@iit.i)

E-mail: michela.chiappalone@unige.it

Address: Via Opera Pia 13, 16145 Genova

Phone:

Description

Motivation and application domain

State spaces generated from features of neural electrophysiological signals have been successfully used for the interpretation of brain phenomena and disorders. A particularly promising application is the construction of bi-dimensional state spaces based on the spectral content of local field potentials (LFP) for the characterization of the sleep-wake cycle (SWC) architecture in both healthy and pathological scenarios. The goal of this project is two-fold: 1) to implement and develop methods of objectively characterizing state spaces for the study of the effects of brain lesions in the SWC of experimental animals; 2) to apply the methodology for the investigation of the effects of brain lesions (acute induction of stroke) in the SWC of experimental animals, and; 3) to assess the putatively beneficial effects of therapeutic neuromodulation.

General objectives and main activities

This thesis falls within the multidisciplinary domains of neurophysiological signal processing, neuromodulation, and neurorehabilitation, under the umbrella of the main field named neuroengineering. The general objectives and specific activities are following:
1. To implement standard metrics of assessing state space, such as position and size of agglomerate of points (clusters), frequency and velocity of transitions.
2. To develop new means of quantifying state space.
3. To integrate state space metrics with other LFP signal processing analysis, such as cross-frequency coupling measures.
4. To develop methods based also on MUA (Multi Unit Activity) analysis
5. To apply all developed methods to datasets collected from animals submitted to experimental stroke and to therapeutic neuromodulation.

Training Objectives (technical/analytical tools, experimental methodologies)

â€¢ Neurophysiological signal processing
â€¢ Data analysis and statistical testing
â€¢ In vivo set-up use and optimization
â€¢ Experiments in vivo (wherever possible)
â€¢ Animal models of neurological disorders
â€¢ Depending on the development: hardware programming using HDL

Place(s) where the thesis work will be carried out: DIBRIS at UniGe and the Istituto Italiano di Tecnologia, Rehab Technologies Lab and the Neuroscience and Brain

Additional information

Pre-requisite abilities/skills: MATLAB programming skills, signal processing, statistics, attitude to experimental work

Curriculum: Neuroengineering

Maximum number of students: 1

Financial support/scholarship: --