MSc/PhD positions in Biomedical Physics and PERFORM centre at Concordia University

We offer two very interesting opportunities for M.Sc or PhD projects in the context of the new Biomedical Physics program proposed at Concordia University by the Department of Physics and PERFORM.

Project 1: Multimodal characterization of resting state functional connectivity.

Supervisor: C. Grova, Department of Physics and PERFORM Center

The overall project aims at assessing the organization of fluctuations of neuronal bioelectrical signals measured from the scalp using either Electro-EncephaloGraphy (EEG) or Magneto-EncephaloGraphy (MEG), while the subject is resting. The main methodological originality of this project is to consider time-frequency based source localization of EEG and MEG data, using wavelet-based Maximum on the Mean wMEM (Lina et al IEEE TBME 2014) in order to investigate resting state functional connectivity from simultaneous EEG/MEG data and also from simultaneous high-density EEG/fMRI data. These multimodal data will be considered in order to investigate the dynamic of resting state functional connectivity patterns in healthy controls

The candidates will join a multidisciplinary team composed of neurologists and methodologists within the Multimodal Functional Imaging Laboratory, directed by Pr. Christophe Grova. Simultaneous EEG/fMRI data will be acquired at PERFORM, while simultaneous EEG/MEG data will be acquired at the Montreal Neurological Institute, McGill University. The key component of this project consists in adapting and validating the performance of EEG/MEG source localization of resting state data in healthy subjects, in order to build a normative database.

Requirements: The candidate should have some knowledge in image and signal processing, linear algebra and statistics, as well as experience in computation and programmation, using notably Matlab software. Any experience with neuroimaging softwares would be an asset.

Project 2: Multimodal characterization of functional hubs.

Supervisor: C. Gauthier, Department of Physics and PERFORM Center

Co-Supervisor: C. Grova, Department of Physics and PERFORM Center

In the overall context of understanding the organization of brain activity during rest, as in the analysis of any network, the notion of “hub”, their detection and characterization is a key and challenging objective. This project will propose and evaluate new methods to detect these hubs and to charactrize their underlying metabolism using quantitative Magnetic Resonance Imaging (MRI) techniques. Using a new method based on sparse modeling to extract the hubs of such network organization from resting state functional MRI data acquired simultaneously with EEG data, the project will consist in combining these techniques with quantitative MRI to measure the metabolic rate of oxygen consumption. To do so, gas manipulations, i.e. breathing controlled amount of CO2 and O2, will be needed during the MRI acquisition. The objective will be to assess hemodynamic fluctuations, neuronal bioelectrical oscillations and local oxygen consumption of these hubs, within a population of healthy controls of different age ranges.

Requirements: The candidate should have some knowledge in image and signal processing, linear algebra and statistics, as well as experience in computation and programmation, using notably Matlab software. Any experience of neuroimaging softwares and in experimental sciences would be an asset.

Please send your CV and motivation letter to
christophe.grova@concordia.ca and claudine.gauthier@concordia.ca