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Seminaires du LPTM , Universite de Cergy Pontoise

Jeudi 17 Octobre 2019, 14 :00
LPTM, 4.13 St Martin II
Domaines : qbio.NC

Titre : *Exact Reduction of Multiscale Neural Dynamics'*

Orateur : **Marco Segneri (LPTM UCP Cergy.)**

Résumé : *This project aims to develop a mathematical theory for how large-scale brain dynamics and function may arise from collective behavior of the underlying neuronal circuits. It goes without saying that network organization of the brain is complex at almost every scale : from small neuronal circuits to large scale networks. This complex architecture poses serious challenges to modeling of neuronal activity and its relationship to cognitive function. In fact, direct simulations of biophysically based spiking neurons, while becoming technically possible due to increased computing power and programming techniques, quickly become unwieldy, difficult to understand beyond observation of simulated results and next to impossible to analyze. An alternative approach are reduced models of population neural activity studied to address large scale data, such as brain activity measured non-invasively with imaging techniques. These can be analyzed, yet are difficult to connect quantitatively with specific neuronal data such as local network structure, neuronal excitability and local network dynamics. We believe that it is precisely such quantitative connection between the different levels that is critical to further progress uncovering the links between biophysics and cognition. In this project we propose to apply a recently developed mathematical formalism, Exact Reduced Methodology (ERM) that takes exactly this step and further validate and apply it to critical questions. In particular, we will employ ERM to mimic the dynamics of realistic neuronal ensembles. Using this powerful formalism we will develop mesoscopic models that are able to summarize quantitatively the large scale collective dynamics, while taking into account properties of the constituent neurons and circuits. Notably we will focus on the ubiquitously observed brain oscillations and particularly on theta-gamma*

cross frequency coupled dynamics that have been linked to cognitive function.