Ecole Doctorale STIC

Sciences & Technologies de l'Information et de la Communication

ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2011

Titre du sujet :	Detecting, Tracking and Classifying axons from neuronal images
Mention de thèse :	ATSI
HDR Directeur de thèse inscrit à l'ED STIC :	Descombes Xavier

Co-encadrant de thèse éventuel :

Nom :	Blanc Feraud
Prénom :	Laure
Email :	Laure.Blanc_Feraud@inria.fr
Téléphone :	0492387714

Email de contact pour ce sujet :	Xavier.Descombes@inria.fr
Laboratoire d'accueil :	I3S/INRIA

Description du sujet :

The goal of this study is to analyze, classify and characterize neurons based on their axons pattern. For that purpose, biologists at IBDC have acquired two types of image sequences : 1) 3D+t image sequences of neurons developing within intact brain using fluorescent bi-photon microscope and 2) static 3D images of mature neurons using confocal microscopy. Images from different populations of neurons, wild-type or mutant, have been collected. This work will focus on describing the morphology of each neuron class. This morphology being clearly linked with the number of partner a neuron can have, we expect to derive and explain some functional behaviour of the neuron of each of the considered classes.

A first step consists in analysing images to extract the axonal tree. A first approach has been proposed in the static case. It consist in denoising the images before applying a skeletonization. Finally, a connection step based on a tensor voting approach is performed. In the PhD we will consider the dynamic case, consisting in a sequence of 3D volume representing a population of

axons in the process of growing. The candidate will develop a multi-body tracking approach to extract the axon trajectories during the growing process. For this task, we will consider the marked point process framework coupled with a tracking technique.

In a second step, the morphology of the different axon classes, either mature or during the growing process, will be described. We will define relevant morphometric parameters to characterize and discriminate the different classes. The shape of the axon tree will be modeled, especially the location and the number of bifurcation points. The proposed model will be validated by hypothesis testing. Finally, the model parameters will be infered from the data. We will study the differences between wild-type and mutant populations and between neuron cultured in vivo and in vitro. From the shape of the axon, we can infer the number of possible connections with neighbouring neurons and therefore get some functional information.

This PhD is a collaboration between I3S, INRIA and IBDC (Institute of developmental Biology and Cancer). The long-term goal is to better understand some neuronal diseases such as the Fragile X syndrome.□□□□□□

English version: