PHD PROPOSAL

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Title: **Modelling and characterizing axon growth from in vivo data**

Keywords: Axon growth, Markov Chain, Estimation, Confocal and two-photon microscopy

Summary: The trajectories followed by axons during their growth define the morphologies of mature axons and therefore underlie neuron network connectivity. Defective axon growth has been linked to various motor and mental disorders. F. Besse team at iBV has identified genes controlling axon growth and has defined a protocol to obtain in vivo image sequences of axons during the growing process in *Drosophila brains*.

The goal of this PhD project is to propose an axon growth model based on Markov Chains, to simulate this model and to estimate its parameters from in vivo data of different populations. The mathematical model will embed biological properties such as the axon elasticity, the attraction toward a predefined target or the speed of growth.

The model parameters estimated from the image data will characterize the different individuals and differentiate different populations. We will consider the static case where the data consist of 3D confocal images of a mature axon and the dynamic case considering time sequences of two-photon images during the growth process.

Different populations of *Drosophila* axons, including mutant ones will be compared. The output of the study will consist in assessing if a given mutation affects the attractive vector field, the axon elasticity, the speed growth and/or the ability of an axon to produce branches in order to identify a therapeutic target.

Work plan:

1) Definition of a 3D growth model
2) Parameter estimation from confocal microscopy images of *Drosophila* axons
3) Mutant population characterization
4) Extension to a 3D+t model
5) Parameter estimation form two-photo time sequences volumes of Drosophila axon growth
6) Mutant population characterization