Institut Langevin & Laboratoire Charles Fabry

Proposition de stage / Internship proposal

Date de la proposition : 24/11/2022

Responsable du stage / *internship supervisor*: Pedro Mecê & Caroline Kulcsár

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Nom du Laboratoire / *laboratory name*: Institut Langevin /Laboratoire Charles Fabry

Etablissement / *institution* : ESPCI Paris / Institut d'Optique

Site Internet / *web site*: https://www.institut-langevin.espci.fr / https://www.lcf.institutoptique.fr

Lieu du stage / *internship place*: 1 rue Jussieu, Paris 75005

Titre du stage / *internship title*: **Design and implementation of a predictive model-based control loop for Full-Field Optical Coherence Tomography in-vivo retinal imaging**

Context:

The retina is part of the central nervous system (CNS). For this reason, several major CNS disorders, such as Alzheimer's disease and Parkinson's disease, occur in the retina and especially in the ganglion cell layer. Due to the optical properties of the eye, the retina is directly accessible to optical imaging with cellular resolution, suggesting that **the eye is a window to the brain and to neurodegenerative diseases**.

Recently, our group at Institut Langevin proposed an optical interference imaging technique, **full-field optical coherence tomography (FFOCT), which achieves high 3D resolution over a wide field of view**, all in a compact system and therefore suitable for clinical application. This system has recently received **two awards for research excellence from international scientific societies in photonics (SPIE) and ophthalmology (ARVO)**. Despite the high performance of this system in terms of resolution, the visualisation of ganglion cells is still elusive. One of the main limitations of the actual system is the involuntary retinal axial motion during image acquisition. Such motion are dominated by low temporal frequency movements provoked by breathing, heartbeat and pulsation, and need to be compensated in real-time to successfully acquire FFOCT images from ganglion cells.

Objectives:

To overcome this limitation, in this project the intern will work on **the design and simulation of a tracking control loop based on prediction methods** to finely compensate for retinal axial motion. Finally, the intern will **validate the developed control loop by implementing it in two FFOCT systems** located at Institut Langevin and Quinze-Vingts Ophthalmology Hospital.

This work will be carried out in interaction with Prof. Caroline Kulcsár (Laboratoire Charles Fabry), expert in optimal predictive model-based control, and Pedro Mecê (Institut Langevin), expert on FFOCT applied for in-vivo retinal imaging. To this end, the recruitment of an intern with a good background in physics in general and control/optics in particular, as well as a marked interest in the interface with ophthalmology or medicine through imaging methods, is desirable.

Internship duration: 3-4 months (Bac+4 or M1 internship)

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Non**

Si oui, financement de thèse envisagé ou acquis / *financial support for the PhD* **?**

Financement acquis / *Secured funding*	oui	Nature du financement */Type of funding*	ANR
Financement demandé / *Requested funding*		Nature du financement */Type of funding*	