Centrale Méditerranée

Proposition de sujet d'alternance 1A 2024-25

Laboratoire : Institut Fresnel

Titre du sujet : Modélisation et caractérisation de filtres accordables pour l'imagerie photo-acoustique neuronale

Encadrant * (s) : 1) Samuel Métais	2) Thomas Chaigne
Nom :	
Prénom :	
Qualité ** : Maitre de Conférence (Centrale Med)	Chargé de Recherche CNRS
Localisation : Institut Fresnel (St Jérôme)	Institut Fresnel (St Jérôme)
Coordonnées samuel.metais@fresnel.fr	Thomas.chaigne@fresnel.fr

(e-mail/tel)

Descriptif du sujet et de la mission (au moins sur la 1er année) :

Introduction :

Understanding the inner workings of the brain requires non-invasive large scale imaging with single neuron resolution. Light however, cannot penetrate deep inside tissues. To overcome such limitation, one can use photo-acoustic imaging, where the light absorbed by the neurons generate elastic wave that can be optically recorded to reconstruct a 3D image of the brain.
In this context, we has designed new ways to enhance the detection of those acoustic waves, based on their modulation of the reflectivity of a narrow-band bandpass filter. In such a Fabry-Perot cavity, light interferes and generates sharp peaks of transmission, depending on the properties of the cavity's spacer. When a photo-acoustic signal modulates the cavity, the reflectivity allows for a reconstruction of the acoustic wave, and hence of the underlying structure.
To optimize this system's limit of detection, one must properly understand and study the propagation of the acoustic wave in the filter, and its interaction with the optical interference that happens inside the Fabry-Pérot cavity.

Subject :

The student for this project will work with both Samuel Métais (RCMO, McF Centrale) and Thomas Chaigne (MOSAIC, CNRS) on two main aspects :
1) Modeling and simulation : Using COMSOL, multiphysics simulation will be performed to understand the coupling of the acoustic wave to the different parts of the system.
2) Experimental work : A simple model experiment will be constructed to validate the simulation results, using both model sources such as transducers and the actual photo-acoustic optical setup.

Application :

This subject is open for students in 1A interested in learning new valuable skills while getting experience in a research lab. With enough motivation and results, the student might have the opportunity to visit other collaborators laboratory to further expand the scope of this work.
Contact either Thomas Chaigne (thomas.chaigne@fresnel.fr) or Samuel Métais (samuel.metais@centrale-med.fr)

Validation pour mise en ligne ECM :