INSTITUT FRESNEL MARSEILLE

Research opportunity at the Institut Fresnel
Internship in biomedical optics

Development of digital tools for the exploitation of measurements from a new type of non-invasive oxy/glucometer

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Background : Optical methods, such as diffuse optical tomography (DOT), are an alternative to conventional biomedical imaging modalities such as X-ray CT, MRI, PET, SPECT, etc. They are gaining momentum in contemporary biomedical research due to their non-invasive nature and their sensitivity to important physiological contrasts that are not readily available with other approaches. Tissue optical parameters are intrinsic biomarkers (absorbing molecules such as oxygenated and reduced hemoglobin) that provide information about tissue and organ metabolism and physiology. Diffuse optics techniques can be used to image vascularity, hemodynamic parameters and oxygen saturation in the so-called "therapeutic window" (600-900 nm). Further into the infrared (SWIR: Short Wave InfraRed or NIR II), other biomarkers such as lipids, water or glucose can also be measured. The main drawback of DOT is that biological tissues are highly scattering and/or absorbing in the spectral windows of interest. This requires the use of complex mathematical models of light propagation in tissues. In the present collaborative project (ANR PRCE L-iOS: CHU Toulouse, CEA LETI, CNRS LPL and Institut Fresnel), we are interested in the optical monitoring of glucose in order to develop a non-invasive monitoring method for diabetic patients. An innovative portable sensor has been developed by our partner and is to be tested. A methodology to exploit the measured signals must be implemented.

The main objective of this internship is to implement the inverse problem solving brick, i.e.: from the experimental data taken in various configurations, knowing the physical model linking the parameters of interest and the measurements, to get an estimate of these parameters.

Research program :

- ⇨ To solve the inverse problem, in the configuration defined by the sensor designers, with the developed reconstruction software, based on the modeling of the propagation of polarized light through biological tissues (Monte Carlo simulations) in order to retrieve quantitative information on tissue physiology (glucose concentration).
- ⇨ To perform experiments *in vitro* and on tissues *ex vivo*.
- ⇨ To perform demonstrative tests with the handheld detector to assess *in vivo* feasibility.

Candidate profile:

Level: Master 2 research or 3A engineering school
Education: physics, applied mathematics, signal and image processing, applied computer science
The candidate will work in a multidisciplinary environment.