Post-doc offer in Computer Science applied to biomedical imaging at Institut Fresnel (Marseille)

Background

The successful applicant will join the collaborative project L-iOS (ANR PRCE 2016) aiming at developing a portable and highly accurate (spatially and spectrally) light sensor array for medical applications. He/she will join DiMABio group at Institut Fresnel and will develop and optimize a Monte Carlo simulator to model light propagation through biological tissues in the visible to mid-infrared (500-1500 nm). In this wavelength range, tissues are modeled as highly absorbing and scattering media. The light propagation phenomenon can be described by the Radiative Transfert Equation. One of the most versatile ways of solving this integro-differential equation is by Monte Carlo simulations. This forward model will be introduced in an inverse problem resolution loop in order to reconstruct the 3D maps of the parameters of interest, such as absorption or reduced scattering coefficients, and, *in fine*, concentrations of the biomarkers of interest (oxy- and deoxy-hemoglobin, glucose, fat…).
The consortium comprises researchers and physicians from four different institutions in France: Toulouse Hospital, Laser Physics Laboratory (Paris), CEA-LETI (Grenoble) and Institut Fresnel (Marseille).

Description of the position

The applicant can base his/her developments on previous research work conducted at DiMABio group. A general Monte Carlo simulation code that takes into account polarization has been developed in Fortran [1]. Reciprocity relations appearing in the formulation of the inverse problem and strategies to improve the computation efficiency have been implemented [2].

In this context, the research program of the applicant could be:

- To apply efficient GPU-based, CPU or hybrid CPU-GPU parallelization processes to speed up the forward model resolution;
- To test different strategies of resolution of the inverse problem at a single wavelength, implement them in realistic situations and validate them with experimental data;
- To propose a reconstruction scheme for spectrally resolved measurements.
- To propose innovative general solutions within this project that could be used in other diffuse optics physical problems (Diffuse Optical Tomography, PhotoAcoustic Tomography, Polarization gating imaging).
- To couple different forward model resolution techniques (mesh-based Monte Carlo), always with the objective to reduce computation complexity.

[1] https://www.cbica.upenn.edu/vmarkel/CODES/MC.html
[2] Tricoli et al. “Reciprocity relation for the vector radiative transport equation and its application to diffuse optical tomography with polarized light,” ArXiv

Qualifications

The applicant should have a strong background in Applied Mathematics and Computer Science. Expertise in physics/optics would be a plus but is not a requirement. He/she will join a group composed of theoretical and instrumental physicists, and will have to interact with the other researchers and engineers of the consortium. Hence, he/she should be independent and present a strong motivation in working in a multidisciplinary environment.

Place : Marseille, Institut Fresnel
Duration : 12 months
Starting date : 2017, January 1st

Send CV + lettre of motivation to anabela.dasilva@fresnel.fr