PhD offer

Development and validation of 3D signal reconstruction algorithms for fluorescence tomography in the second biological window (SWIR)

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We propose a PhD project (CIFRE funding) in the field of modeling and image processing for biomedical optical imaging. The mission is part of a collaborative project between the Institut Fresnel in Marseille, the Optimal platform of the Institute for the Advancement of Biosciences (IAB) in Grenoble, and the company Kaer Labs in Nantes, for the development of a fluorescence tomography system in the second biological window. The mission of the PhD student will be to develop 3D reconstruction algorithms for the localization of fluorescence sources.

Biomedical optical imaging is a rapidly growing non-conventional imaging technique. Fluorescence Diffuse Optical Tomography is a non-invasive imaging technique capable of detecting and quantifying fluorescent sources located in deep organs in living organisms (rodents). The technique uses non-ionizing radiation in the so-called SWIR (short wave infrared) spectral range (from 900 nm to 1700 nm, the second biological window), where biological tissues have lower scattering coefficients than in the visible or near infrared range.

The PhD project concerns the development of a reconstruction algorithm exploiting fluorescence images from a small animal fluorescence imaging system similar to the one described in the publications [1-4] but in the so-called "NIR-II" or "SWIR" spectral range (1000 to 1700 nm). This algorithm must: i) be based on the numerical resolution of a light propagation model able to take into account the high levels of absorption and scattering

of biological tissues at these wavelengths (Radiation Transfer Equation); ii) take into account the technical characteristics of the instruments (acquisition geometry, type of sensor and source, fluorescence filter...). The candidate will be able to rely on preliminary work and numerical tools already implemented, as well as on the expertise of the team.
The successful candidate will integrate a team composed of several researchers involved in specific research projects, notably in polarization imaging and photoacoustic tomography.

Profile required
The main skills required for the project are in scientific computing (numerical analysis for PDEs, optimization, algorithms, deep learning and HPC), signal and image processing. Knowledge of physical models would be a plus.
Master's degree in applied mathematics, physics, computer science, image processing or similar field.

Programming languages: C/C++, Python, MATLAB, VTK, Knowledge of CUDA would be a plus.
Autonomy
Experience

Duration of the mission: 36 months

Start of the mission : TBD

[1] L. Hervé, A. Koenig, A. Da Silva, M. Berger, J. Boutet, J.M. Dinten, P. Peltié, P. Rizo, *NonContact Fluorescence Diffuse Optical Tomography of Heterogeneous Media*, Applied Optics **46**(22), 4896- 4906, 2007.

[2] L. Hervé, A. Da Silva, A. Koenig, J.-M. Dinten, J. Boutet, M. Berger, I. Texier, P. Peltié and P. Rizo, *Fluorescence tomography enhanced by taking into account the medium heterogeneity*, Nuclear Instruments and Methods in Physics Research A, **571** (1-2) 60–63, 2007.

[3] Anne Koenig, Lionel Hervé, Véronique Josserand, Michel Berger, Jérôme Boutet, Anabela Da Silva, Jean-Marc Dinten, Philippe Peltié, Jean-Luc Coll, Philippe Rizo, *In vivo mice lungs tumors follow-up with fluorescence diffuse optical tomography*, Journal of Biomedical Optics **13**(1), 011008 2008.

[4] Koenig A, Hervé L, Gonon G, Josserand V, Berger M, Dinten JM, Boutet J, Peltié P, Coll JL, Rizo P. Fluorescence diffuse optical tomography for free-space and multi-fluorophore studies. J Biomed Opt. 2010 Jan-Feb;15(1):016016. doi: 10.1117/1.3309738. PMID: 20210462.