Doctoral position on image reconstruction for ultrasound modulated optical tomography

Host institute   [Multimodal Biomedical Imaging Laboratory](#) (BioMaps), University of Paris-Saclay / French Atomic Energy Commission (CEA) / CNRS / INSERM, Orsay, France.

Partner institute [Institute Langevin](#), ESPCI Paris / University PSL / CNRS, Paris France.

Supervisors   Claude Comtat – claude.comtat@universite-paris-saclay.fr
François Ramaz – francois.ramaz@espci.fr

Topics   Image reconstruction; inverse problems; optical imaging; medical imaging.

Duration   3 years, starting in September 2024.

Doctoral School [Electrical, Optical, Bio-physics and Engineering](#) (EOBE), University Paris-Saclay.

A three-year doctoral position funded by CEA is opened at [BioMaps](#) in Orsay, in collaboration with the Institute Langevin in Paris. The recruited person will by employed by CEA with a [research-based training contract (CFR)](#).

Scientific Context

Local optical properties of a biological tissue can provide useful information to improve medical diagnosis. However, non-invasive optical imaging deep inside the tissue remains a challenge, because of strong light scattering. The use of the acousto-optic effect between the light and the ultrasound (US) was proposed as a solution to achieve high-resolution images of optical contrast deep inside the tissue: US modulated optical tomography (UOT) [1]. So far, UOT was developed on experimental optical bench with focus US, requiring several minutes for data acquisition. **The challenge for a clinical use of UOT is the acceleration of the data acquisition by one order of magnitude without degradation of the signal-to-noise ratio**.

Working Hypothesis and Aims

For a clinical use of UOT, spatially and temporally structured planar US waves with the addition of an angular dimension are promising. However, unlike focus US where the imaging problem is direct, structured planar waves requires a numerical processing to reconstruct an image, similar to limited-angle X-Ray tomography [2]. **The aim of the thesis is the development, implementation, demonstration, and evaluation of tomographic reconstruction methods in UOT with structured US waves with a view to transferring the technology to a clinical use**. More specifically, the candidate will:

- Contribute to the development of new optimization algorithms for UOT image reconstruction, starting from algorithms developed at BioMaps for image reconstruction in nuclear medicine;
- Integrate these optimization algorithms in the open-source [CASToR](#) reconstruction platform [3];
- Apply and evaluate these techniques with data acquired with physical phantoms and tissue samples on experimental setups for acousto-optic imaging installed at BioMaps and at the Institut Langevin.

Profile required

- Education: Master 2 degree in Physics, Applied Mathematics or Signal and Image Processing;
- Scientific interest: Numerical Sciences, Medical Applications, Optical Instrumentation;
- Programming skills: C/C++, Python;
- Language: English, French optional.

How to apply

For more details on the position, please contact claude.comtat@universite-paris-saclay.fr and francois.ramaz@espci.fr. To apply, send your CV and a cover letter.

[1]   Q-M. Thaï *et al*., Biomed. Opt. Express 13, 6484-6496 (2022), [DOI 10.1364/BOE.475449](#)
[2]   M. Bocoum *et al*., Opt. Lett. 45, 4855-4858 (2020), [DOI 10.1364/OL.396688](#)
[3]   T. Merlin, S. Stute *et al*., Phys. Med. Biol 63, 185005 (2018), [DOI 10.1088/1361-6560/aadac1](#)