3D optical computational microscopy for quantifying T lymphocyte activation

laboratory : Institut Fresnel Marseille France, http://www.fresnel.fr

Supervisor: Guillaume Maire, *Professor assistant AMU*
Tel: 04 91 28 84 93, guillaume.maire@fresnel.fr

Co-supervisors :Philippe Robert : philippe.robert@inserm.fr *medical doctor*
Anne Sentenac: anne.sentenac@fresnel.fr *senior researcher ,fellow OSA*

This project is centred on a promising label-free optical imaging technique, tomographic diffraction microscopy, and targets medical diagnosis applications by characterizing sub-micrometer conformational changes of T lymphocyte cells.
T lymphocyte activation is a key feature of the immune response, during which the adaptive immune system detects specific none-self antigens prior to induce targeted responses. Presently, no technique permits to perform a fast detection of T lymphocyte activation at an early stage, which is detrimental for the diagnosis of numerous diseases (from infection diseases to allergy).
T lymphocyte activation is triggered by several signals exchanged between the lymphocyte and an antigen presenting cell. After the very early steps of activation, a highly organized interfacial structure appears between the two cells, called an immunological synapse [1]. We propose a new approach for quantification of T lymphocyte activation based on the early detection of these immunological synapses.
Presently no standard optical microscopy technique has the necessary 3D resolution to tackle this issue. We have recently shown that optical tomography coupled to sophisticated inversion schemes could be a good candidate for this task[2]. In this project, we propose to develop a computational tomographic microscope dedicated to the visualization of the immunological synapses. The student will build a microscope inspired from an already existing prototype and adapt the inversion scheme to the specific application. The imaging tool will be transferred to the Hospital La Conception and tested on human blood samples. Statistical tools for evaluating the activation of the T lymphocyte will be developed to help the medical diagnosis.
The candidate will interact with experts in optical instrumentation (Guillaume Maire), data processing (Patrick Chaumet) and a medical doctor specialized in inflammation (Philippe Robert). We are looking for talented and motivated applicants with a background in physics-engineering and/or signal processing motivated by the medical application. More information on doc2amu links.

Références :

[1] **Robert P**, Aleksic M, Dushek O, Cerundolo V, Bongrand P, van der Merwe PA. Kinetics and mechanics of two-dimensional interactions between T cell receptors and different activating ligands. Biophys J. 2012 Jan 18;102(2):248-57, 2012.

[2] Ting Zhang, Charankumar Godavarthi, Patrick C. Chaumet, **Guillaume Maire**, Hugues Giovannini, Anne Talneau, Marc Allain, Kamal Belkebir, and **Anne Sentenac** "Far-field diffraction microscopy at λ/10 resolution", Optica, Vol. 3, 609-612, 2016.

The perks of a MARIE CURIE Cofund grant

Salary 1625€ per month (social security included)
500 € per year for personal travels.
Up to 30 000 € for international mobility [collaboration with IPHT in Jena (Germany) and Boston University (USA)]
12500 € for research equipment.
Grants for workshops and international meetings
Possibility to attend to numerous courses (science and french foreign language)