Master's Degree Training Period:
Quantitative phase imaging using structured illumination

IRIMAS has developed a Tomographic Diffraction Microscope (TDM) that allows for full 3-D imaging of microscopic transparent samples (Opt. Lett. **34**, p. 79 (2009), Optica **4**, p. 460 (2017)), by acquiring and fusing many phase images, usually holograms.

Leida Technologies develops innovative illuminating devices for transmission microscopy, such as the µLightLT system (https://www.leida.fr/Produits.htm), which allows for fine control of the illumination of the specimen. This permits several imaging modalities onto the same setup, and easy switching from one modality to another. For example, wide-field, dark-field or even phase contrast images can be easily obtained (see Fig. 1)

Such images are however qualitative only: the measured grey levels do not constitute a direct measurement of physical quantities such as optical path difference, index of refraction, or absorption: indeed, because intensity-only images are recorded, information such as phase is lost.

But in principle, such intelligent illumination can turn any transmission microscope into a quantitative phase imaging system, if appropriate image reconstruction methods are applied.
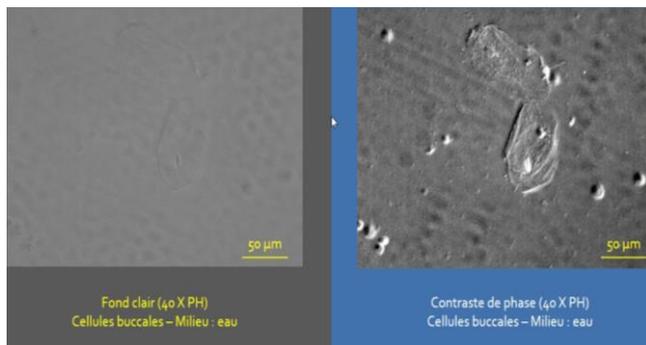

Figure 1: wide-field (left) and phase contrast (right) images of epithelial check cells obtained on the same microscope, using a µLightLT system

The proposed work, in association between Leida Technologies and IRIMAS will consist in developing a dedicated computer code to appropriately reconstruct quantitative phase images from sets of intensity-only images, obtained by varying the illumination conditions using a µLightLT device:
- Bibliographic research
- Implementation of reconstruction methods according to the bibliography (also starting from already existing codes), simulations and comparison of results.
- Imaging of test samples
- Comparison with Tomographic Diffraction Microscopy and/or holographic microscopy.

Expected skills: autonomy, resourcefulness, and creativity. Strong analytical skills, as well as computational skills are mandatory.

Duration: **4 to 6 months**

Prolongation: depending on achievement and funding, a PhD will be proposed on the subject.

References:

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