WIDE-FIELD OF VIEW QUANTITATIVE PHASE IMAGING

Isaure de Kernier[a,b,*], Nelly Rongeat[c], Sophie Morales[a], Serge Monneret[b], Pierre Blandin[a]

[a] Univ. Grenoble Alpes, CEA, LETI, F-38000 Grenoble, France; [b] Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, Marseille, France; [c] HORIBA ABX SAS, Montpellier, France

***email : isaure.dekernier@cea.fr**

We present a 30 mm^2 field of view microscopy set-up based on the use of a macro-photography lens. It achieves a resolution below 4 µm on the entire imaging area, with minimal optical aberrations. The initial purpose of the set-up was to perform single-shot statistical studies of blood cell populations in fluorescence imaging. However, such an imaging system also enables to obtain quantitative phase information. In this work we implemented a quantitative phase imaging modality in the very large field of view set-up.

Phase holds information on an optical wave-field and in particular on the refractive index, optical thickness and topology of the sample in the optical path. It can be used to quantify cell dry mass in biology [1] or quantify the depth of defects in bulk materials. For numerical reconstructions of quantitative phase maps, we used an algorithm based on the Transport of Intensity Equation [2]. To enable very wide field reconstructions on noisy images [3] we included a signal to noise ratio dependent term in the numerical reconstruction.

As illustrated in Figure 1, by comparing the reconstructed phase maps to another quantitative phase imaging method [1], we demonstrated quantitative analysis of structured features in a glass slide over a large area. We also applied the set-up to phase and fluorescence imaging of human blood cells and fixed labelled epithelial cells.

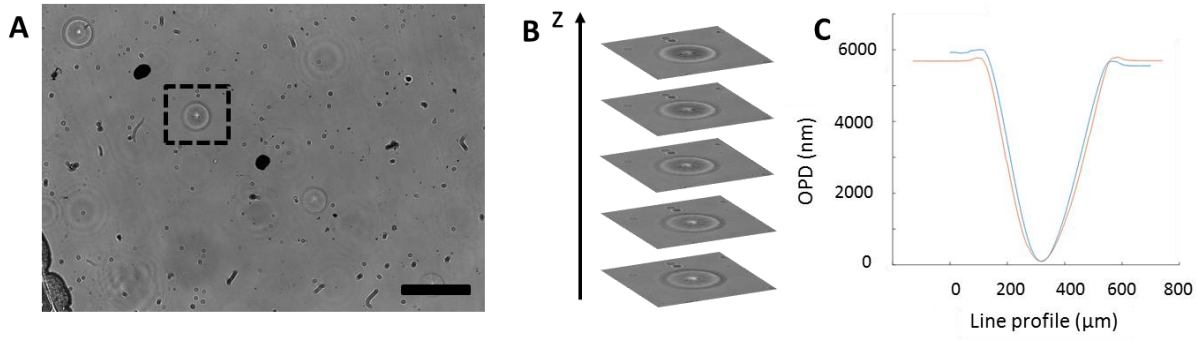

Fig. 1: (A) Full-field of view image of the defects on a glass slide. Scale bar is 1 mm. (B) Z-stack of a cropped region used for numerical reconstruction of the phase map. (C) Reconstructed Optical Path Difference profiles of the cropped region. The proposed set-up (blue line) is compared to the reference method (orange line).

[1] P. Bon, G. Maucort, B. Wattellier, and S. Monneret, "Quadriwave lateral shearing interferometry for quantitative phase microscopy of living cells," *Optics express* **17**(15), 13080–13094 (2009).
[2] L. Waller, L. Tian, and G. Barbastathis, "Transport of Intensity phase-amplitude imaging with higher order intensity derivatives," *Opt. Express*, OE **18**(12), 12552–12561 (2010).
[3] D. Paganin, A. Barty, P.J. McMahon, and K.A. Nugent, "Quantitative phase-amplitude microscopy. III. The effects of noise," *Journal of Microscopy* **214**(1), 51–61 (2004).