

VERSATILE QUANTITATIVE PHASE IMAGING SYSTEM APPLIED TO HIGH-SPEED AND LOW NOISE INTRACELLULAR MOVEMENTS ANALYSIS

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Quadriwave lateral shearing interferometry (QWLSI) is a well-established quantitative phase imaging (QPI) technique based on the analysis of interference patterns of four diffraction orders by an optical grating set in front of an array detector [1]. As a QPI modality, this is a non-invasive imaging technique which allows to measure the optical path difference (OPD) of semi-transparent samples.

We present a system enabling QWLSI with high-performance cameras [2] and apply it to perform high-speed imaging, low noise as well as multimodal imaging. This modified QWLSI system contains a versatile optomechanical device which images the optical grating near the detector plane. Such a device is coupled with any kind of camera by varying its magnification.

In this study we use a sCMOS Zyla5.5 camera from Andor and a CMOS Miro M120 from Ametek Vision Research, along with our modified QWLSI system.

We will present high-speed live cell imaging, up to 730 Hz frame rate, in order to follow intracellular fast motions while measuring the quantitative phase information. We measure the dry mass [3] and dynamics of optical density map of cells, in regular conditions as well as during stimulated blebbing. This phenomenon is fast and can't be easily studied with more classical QPI. The structural and density information extracted from the OPD signal is complementary to the specific and localized fluorescence signal [2], which can be simultaneously acquired. Fluorescence is used to monitor actin structures dynamics.

[1] P. Bon, G. Maucort, B. Wattellier, and S. Monneret, "Quadriwave lateral shearing interferometry for quantitative phase microscopy of living cells," *Optics Express*, **17**, 13080–13094 (2009).

[2] P. Bon, S. Lécart, E. Fort and S. Lévêque-Fort, "Fast label-free cytoskeletal network imaging in living mammalian cells," *Biophysical journal*, **106** (8), 1588-1595 (2014).

[3] S. Aknoun, J. Savatier, P. Bon, F. Galland, L. Abdeladim, B. Wattellier, and S. Monneret, "Living cells dry mass measurements using Quantitative Phase Imaging with Quadri Wave Lateral Shearing Interferometry. An accuracy and sensitivity discussion", *Journal of Biomedical Optics*, **20** (12), 126009 (2015).