HIGH-RESOLUTION QUANTITATIVE PHASE MICROSCOPY BASED ON DIFFERENTIAL INTERFERENCE CONTRAST

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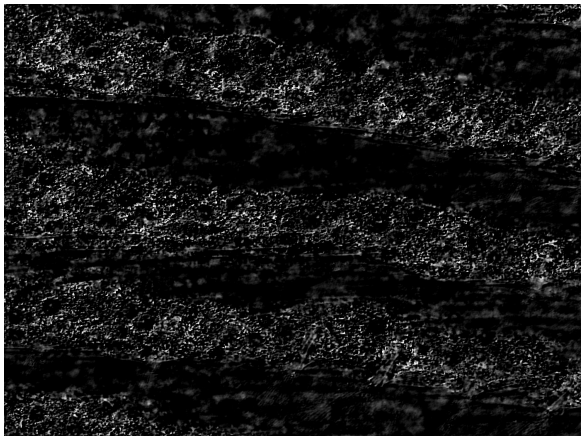
The quantitative phase microscopy (QPM) based on differential interference contrast (DIC) offers significant advantages in comparison to other currently available QPM techniques. It uses unrestricted full numerical aperture (NA) of the illumination and imaging beams and therefore provides the highest lateral and axial resolutions, and has the lowest light energy lost and the shortest exposure time. Because of wide-spectrum non-coherent illumination the image does not suffer from speckle noise. The user can choose a spectral range that is most suitable for the specimen. The optical image subtraction of two slightly different wavefronts allows observation of deep layers in scattering specimen.

We will report about new developments of QPM, which is called the quantitative orientation-independent differential interference contrast (OI-DIC) microscopy [1, 2]. Compact two-prism OI-DIC sliders can easily replace regular DIC sliders without any modification of the microscope can be combined with all imaging modalities.

In particular, newly developed background correction procedure subtracts two complex images, specimen phase gradient and background phase gradient. The new procedure allows to compute a phase map more precisely and suppresses possible 2Pi phase jump in the gradient image. In additional we analyzed a phase unwrapping problem, which is critical for other types of the QPM. We found that in our microscope the phase jumps are well within the Nyquist sampling criterion, so unwrapping shouldn't be a necessary preprocessing step.



We also updated the inverse Riesz computation, which sometime previously produced images of live dense tissues with streaks. The updated Riesz computation eliminated this problem.

Figure 1: OIDIC image of a dense freshly dissected wing butterfly tissue computed with updated inverse Riesz transform.

[1] M. Shribak, and S. Inoué, "Orientation-independent differential interference contrast microscopy", *Applied Optics*, **45** (3), 460-469 (2006).

[2] M. Shribak, K.G. Larkin, and D. Biggs, "Mapping of optical path length and image enhancement using orientation-independent differential interference contrast microscopy", *Journal of Biomedical Optics*, **22** (1), 16006, 1-12 (2017).