DIGITAL HOLOGRAPHIC PHASE CONTRAST MICROSCOPY FOR QUANTITATIVE IMAGING OF LIVING CELLS

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ABSTRACT

Digital holographic microscopy (DHM) provides contact-less, label-free, quantitative phase-contrast imaging [1,2] for modular integration into commercial microscopes [3]. The reconstruction of digitally captured holograms is performed numerically. Thus, multi-focus imaging of sample parts in different layers is achieved from a single digital hologram.

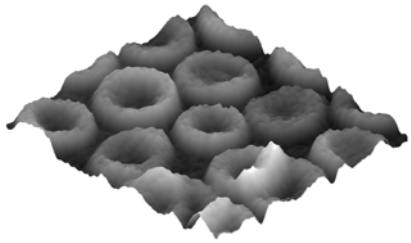

Figure 1: Quantitative holographic phase contrast image of human erythrocytes (gray level coded pseudo 3D plot).

The evaluation of the obtained quantitative phase contrast images provides data for dynamic thickness monitoring, and the analysis of fluidics. The DHM feature of (subsequent) numerical autofocus [4,5] enables applications in the field of live cell analysis by avoiding mechanical focus realignment and the determination of axial sample positions. In this way, long term time-lapse investigations in toxicology and cancer research, monitoring of fast dynamic processes like shape variations and 3D cell tracking is achieved. In addition, the integral cellular refractive index and its statistics are available.

In an overview results from investigations on toxin induced reactions of cancer cells, cell swelling kinetics, cell division analysis and refractive index measurements are shown. Furthermore, the analysis of the cell response to optical manipulation, shape variations of sedimenting human erythrocytes, reactions of cells to different substrates and 3D cancer cell migration in a 3D tissue model prospect new application fields of DHM for quantitative cell imaging in Life Sciences.

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