THE ROLE OF DIGITAL HOLOGRAPHIC MICROSCOPY IN THE CLASSIFICATION OF CELLULAR MORPHOLOGIES

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1. ABSTRACT:

In the cell biology, microscopy study of cellular morphology belongs to the essential research techniques. With the increasing prevalence of automated image acquisition systems generating large image datasets, manual evaluation of cell morphology becomes time-consuming and requires considerable effort and concentration of a trained biologist. Moreover, the results largely depend on personal skills, decisions, and preferences. Consequently, these aspects impose significant constraints on the speed and reliability of the cellular morphology evaluation.

One of the approaches to address these limitations is machine learning. Lately, the algorithms of machine learning are increasingly being applied to classification of microscopy images. Such solution provides an objective unbiased method of scoring the content of microscopy images in contrast to subjective manual interpretation, thus potentially being more sensitive, consistent, and accurate.

When it comes to classification of cellular morphologies, the whole spectrum of microscopy techniques are commonly applied. However, most of them provide only intensity images and do not detect the phase shift induced by the imaged cells. Digital holographic microscopy (DHM) enables such phase detection and hence provides quantitative phase images of live cells with high intrinsic contrast without labelling. The phase in the image corresponds to the dry mass density distribution within the cell. As such, DHM provides additional information, which has a great potential to favour the classification of cells.

Here we compare the classification of cellular morphologies based on quantitative phase images with the previously known techniques based on intensity images. Quantitative phase images were acquired using Q-Phase multimodal holographic microscope (TESCAN ORSAY HOLDING, a.s.), which is based on the original concept of coherence-controlled holographic microscope [1,2]. The results of the experiments show that the phase information gained by DHM increases the performance of the classification of cellular morphologies. This outcome shows a potential of DHM to become a versatile tool for the cell classification.

2. REFERENCES:

[1] P. Kolman, and R. Chmelik, "Coherence-controlled holographic microscope," *Optics Express* 18.21, 21990-22003 (2010).

[2] T. Slaby et al., "Off-axis setup taking full advantage of incoherent illumination in coherence-controlled holographic microscope," *Optics Express* 21.12, 14747-14762 (2013).

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