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Non Interferometric Quantitative Phase Imaging of Yeast Cells

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Abstract : In biology most microscopy specimens, in particular living cells are transparent. In cell imaging, it is hard to create an image of a cell which is transparent with a very small refractive index change with respect to the surrounding media. Various techniques like addition of staining and contrast agents, markers have been applied in the past for creating contrast. Many of the staining agents or markers are not applicable to live cell imaging as they are toxic. In this paper, we report theoretical and experimental results from quantitative phase imaging of yeast cells with a commercial bright field microscope. We reconstruct the phase of cells non-interferometrically based on the transport of intensity equations (TIE). This technique estimates the axial derivative from positive through-focus intensity measurements. This technique allows phase imaging using a regular microscope with white light illumination. We demonstrate nano-metric depth sensitivity in imaging live yeast cells using this technique. Experimental results will be shown in the paper demonstrating the capability of the technique in 3-D volume estimation of living cells. This real-time imaging technique would be highly promising in real-time digital pathology applications, screening of pathogens and staging of diseases like malaria as it does not need any pre-processing of samples.

Keywords : axial derivative, non-interferometric imaging, quantitative phase imaging, transport of intensity equation
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