DIGITAL MICRO-MIRROR DEVICE BASED COMMON-PATH QUANTITATIVE PHASE IMAGING

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1. PRINCIPLES

Quantitative phase imaging (QPI) has been widely applied in biological imaging and material metrology due to its high throughput and noninvasive nature. The later development of common-path interferometry inherently eliminates the mechanical vibrations and air fluctuations therefore achieving phase sensitivity better than a few milliradians[1].

We proposed a new common-path quantitative phase imaging system based on a digital micro-mirror device (DMD) and a Fourier plane pinhole filter. The DMD is placed in conjugate to the objective back aperture plane for generating two plane waves to illuminate the sample. A pinhole is used to filter one sample beam to create a reference beam. Additionally, a transmission-type liquid crystal device (LCD), placed at the objective back-aperture plane, eliminates the specular reflection noise arising from the “off” state DMD micromirrors.

2. IMAGING VERIFICATION

We first conducted experiments with calibrated polystyrene beads to verify the phase measurement accuracy, as shown in Fig.1. In addition, we measured the dynamic height maps of red blood cell (RBC) membrane fluctuations. In Fig.2 (a), we present one of the height maps of a typical discocyte. Its membrane fluctuation is quantified by a standard deviation map of the height fluctuation [Fig.2 (b)]. The results agree well with the previous reports and illustrate the system’s efficacy for live cell imaging.

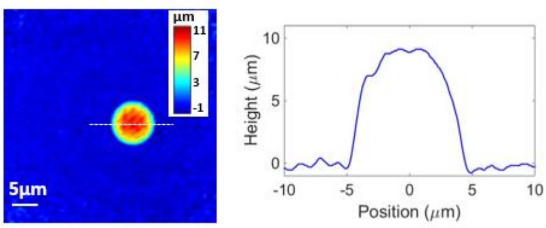

Figure 1: Quantitative phase imaging of polystyrene bead

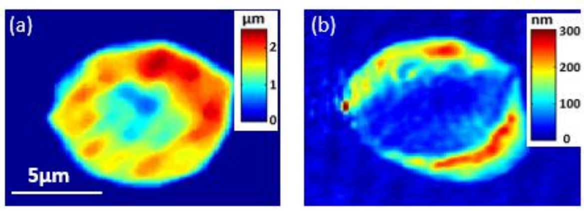

Figure 2: Quantifying the membrane fluctuations of a live RBC

The DMD grants the system convenience in varying the interference fringe period on the camera to easily satisfy the pixel sampling conditions, and it also alleviates the pinhole alignment complexity. In the future, to take the advantage of fast illumination angle scanning of DMD, high-speed synthetic aperture imaging can also be demonstrated.

REFERENCE:

1.G. Popescu, Quantitative phase imaging of cells and tissues. (McGraw Hill Professional, 2011).