Phase microscopy with oblique fields

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Phase contrast microscopy has had a resurgence of interest during the past decade, particularly owing to the development of methods that are quantitative and fast. I will present two such methods developed in our lab.

The first method is called Oblique Back-illumination Microscopy (OBM), and is used in a reflection configuration with oblique illumination from multiply scattered light. OBM provides images similar to Differential Interference Contrast (DIC) microscopy, but can be applied to arbitrarily thick samples. OBM can be setup in both widefield and scanning configurations, and is especially suitable for endomicroscopy. After providing an overview of OBM, I will discuss several new directions we are taking the technique. In particular, I will discuss an extended depth of field mode, providing in-focus imaging over depth ranges close to 100 microns. I will present videos taken with our extended depth of field system and our fiber bundle endoscope.

The second method is called Partitioned Aperture Wavefront (PAW) imaging, and is used in a transmission configuration with oblique detection. PAW imaging has the advantage of being fast (single shot), achromatic (works with white light), and light efficient (works with extended sources). I will show how PAW microscopy provides quantitative phase contrast in thin samples, allowing the possibility of numerical refocusing. PAW microscopy also enables the possibility of user adjustable parallax in absorbing or fluorescent samples, providing a simple technique for real-time pseudo-3D imaging.