Fourier-ptychographic microscopy: achievements and applications

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Fourier ptychography [1, 2] is a computational- microscopy technique based on a standard microscope where the traditional sample illumination has been replaced by an array of LEDs. By taking one image of the sample for each LED sequentially, one gets a set of images that can be used to reconstruct both the amplitude (absorption profile) and the phase (depth profile) of the imaged object, with a resolution far beyond the Rayleigh resolution limit imposed by the optics and the digital CCD camera Nyquist limit. In other words, one single high-resolution wide field-of-view (gigapixel) image is obtained after the numerical manipulations.

In this talk, I will explain the theoretical background, and major achievements that have been achieved by the community. In addition, at USN and NTNU, we have developed a number of improvements to extend the concepts of Fourier Ptychographic microscopy. We are working to develop better hardware, pushing the limit for highest possible resolution and better computational algorithms for high-speed high-resolution wide-field imaging. Such systems can be used for Lab-on-Chip platform imaging and cell identification with low cost hardware.

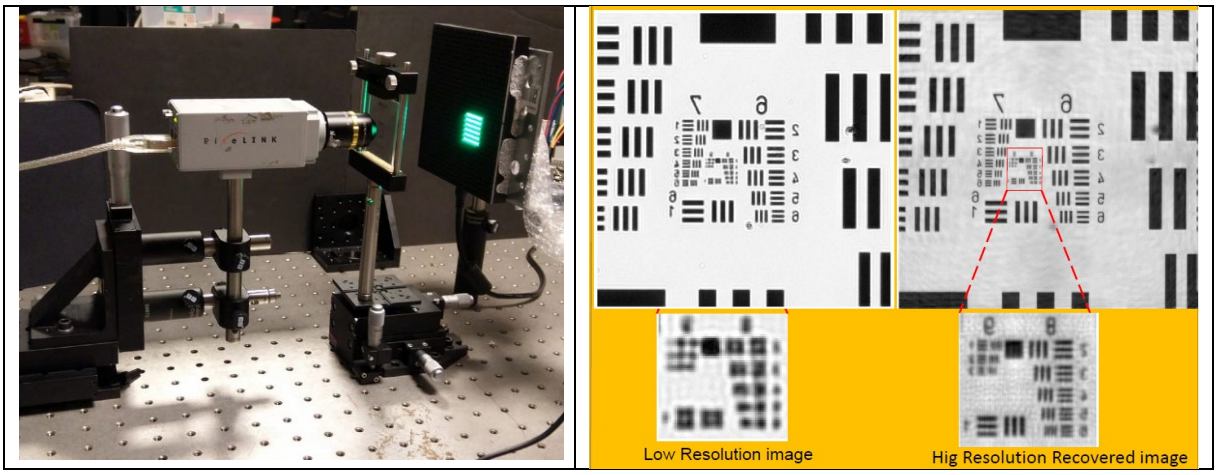

Figure. Fourier Ptychography Setup with LED array, CMOS camera and optics (Left). Low-resolution image acquired using the camera and reconstructed high resolution image (Right).

1- G. Zheng, R. Horstmeyer, and C. Yang, “Wide-field, high-resolution Fourier ptychographic microscopy”, Nat. Photonics 7, 739–745 (2013).
2- L. Tian and L. Waller, “3D intensity and phase imaging from light field measurements in an LED array microscope,” Optica 2, 104–111 (2015).