PLENOPTIC EYEPIECE: A NEW PARADIGM FOR 3D LIGHTFIELD MICROSCOPY

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Plenoptic (also known as lightfield) cameras began to be commercialized at the end of the 2000's and now many companies are beginning to present lightfield displays. Both devices are based on integral photography technique [1]: by inserting a lens array in front of the sensor, it is possible to register the angular information of the rays proceeding from the scene, which is fundamental for the 3D reconstruction.

The same concept can be applied to optical microscopy. The first approach was to place a microlens array at the image plane of the microscope [2]. This system has very poor lateral resolution, which is a critical parameter in microscopy. Later, the resolution was improved moving the microlens array far away from the image plane [3]. However, this causes vignetting effects, which reduce the number of useful pixels behind each microlens.

Recently, a completely new approach for lightfield microscopy was proposed, which consists in putting the microlens array at the aperture stop [4]. In this way, multiple orthographic perspectives of the sample are captured. This system provides much better resolution and larger depth of field than the previous ones, and also avoids the vignetting issue.

Based on this new concept, our work is focused on developing the plenoptic eyepiece: a portable plug-and-play device that converts any conventional optical microscope into a lightfield microscope. The dedicated software processes the images captured by the plenoptic eyepiece to provide the 3D information of the sample.

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