LIGHT FIELD MICROSCOPY FOR NEUROBIOLOGICAL AND BEHAVIOURAL STUDIES OF *C. ELEGANS*

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The model organism *C. elegans* is widely used in fundamental studies of physiology and development as well as drug screening. The relative simplicity of its nervous system (hermaphrodites have only 302 neurons), combined with its optical transparency make it well suited to studying neuronal activation and signal processing using fluorescent calcium ion indicators such as GCaMP. However, to fully capture behavioural and neurological information about the organism requires high speed volumetric imaging which is impossible using most microscopy techniques.

In a light field microscope, a microlens array is mounted at the native image plane of a conventional microscope, allowing simultaneous capture of multiple perspective views of an object [1]. By sacrificing lateral spatial resolution this allows recording of 3D image information at the frame rate of the camera. We have applied light field microscopy to perform volumetric fluorescent calcium imaging *C. elegans* [2]. Computational depth estimation methods, based on defocus and correspondence (angular variance) depth cues, enable reconstruction of the 3D body shape of freely moving organisms (Fig. 1) from brightfield or differential interference contrast (DIC) light field images. Taken together these approaches are a powerful tool for empirical studies and assays using *C. elegans* and other model organisms.

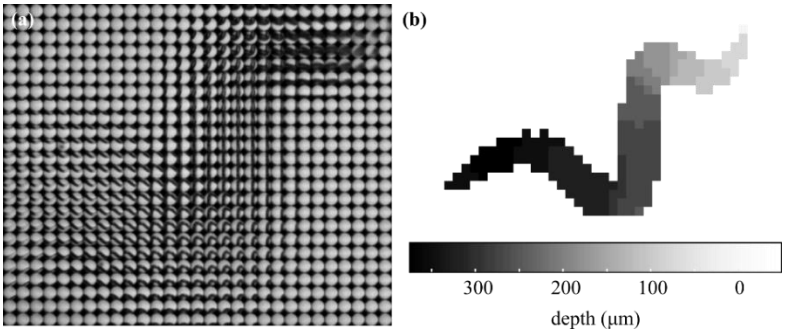

Figure 1. (a) Raw DIC light field micrograph of a *C. elegans* organism. (b) Corresponding grayscale depth map computed by combining defocus and correspondence depth cues.

[1] M. Levoy, et al., "Light field microscopy", ACM Transactions on Graphics, **25** (2006)

[2] M. Shaw et al., "Investigation of mechanosensation in *C. elegans* using light field calcium imaging", *Biomed. Opt. Express*, **7**, 2877-2887