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High resolution 3D imaging using tiling light sheet microscopy

To understand the structure and function of a living matter, scientists rely on microscopic imaging methods. The behavior and interactions between cells in the developing embryos happen in a three dimensional environment. Hence, we need a microscope to record data in three dimensions. Light sheet microscopy is a novel technique which has the capability to acquire a 3D images with high resolution and high imaging speed. The main purpose of the light sheet microscope is the investigation of large biological samples. For this purpose, the imaging field of view should be large enough to cover the whole sample. On the other hand, a large field of view requires an illumination beam with large beam waist, which causes a weak optical sectioning and low axial resolution. Hence, the trade-off between the field of view and axial resolution is remained a challenge. Here we implemented a new method which is called tiling method to acquire a 3D image of Drosophila embryo as a large sample with high spatial resolution in all directions. Instead of trying to generate a light sheet with thick beam waist, a thinner illumination beam which has smaller field of view was tiled in several positions to compensation the field of view. Hence, in each plane were imaged several times, related to the number of tiles. Then the final imaged can be easily achieved by stitching the tiles. With this method, we are able to record the whole functional 3D image from a multicellular organism with cellular resolution.

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