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An Introduction to Volume Electron Microscopy and Its Application to the Study of Neuronal Connectome

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EXTENDED ABSTRACT: During the last century, basic knowledges of neurons and brains are well understood. For example, the patch-clamp technique is invented to detect the ionic flow of a single ion channel in a single neuron [1], and the invasive electrode is invented to study the connection between animal's behaviors and neuronal spikes [2]. Scientists have made great strides in understanding the brain, however, how billions of neurons connect to each other and realize brain functions is still a mystery. Up to now, volume electron microscopy is the only way to investigate neuronal connectivity with the resolution of neuronal synaptic level (~4 nm), and with the range of millimeters (size of a mice brain) at the same time. Volume electron microscopy can be achieved in both scanning electron microscope (Serial block-face SEM) and transmission electron microscope (Serial sectioning TEM) [3]. Ultra-thin section or focused ion beam irradiation (FIB-SEM) is applied to cut the 3D sample into slices [3]. Then, sections are imaged in electron microscope, and large amount of imaging data are obtained. Finally, the whole volume is reconstructed through automatic stitching and alignment. To be noticed, the imaging of a cubic volume (1 mm) in the voxel resolution of 4 nm may need years to finish. Therefore, multiple-beam scanning electron microscope, using multi-scanning-beams (up to 91 beams) at a same time, is invented to accelerate the acquiring speed [3].

Keywords： connectome; volume electron microscopy; multiple-beam scanning electron microscope; medial entorhinal cortex; ATUM; grid cell;

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BIOGRAPHY

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