Toward integrative connectome of the *Drosophila* brain

Ann-Shyn Chiang\textsuperscript{1,2}

\textsuperscript{1}Brain Research Center, National Tsing Hua University, Hsinchu 30013, Taiwan, ROC
\textsuperscript{2}Kavli Institute for Brain and Mind, University of California, San Diego, La Jolla, CA 92093-0526, USA

Email: aschiang@life.nthu.edu.tw

ABSTRACT

Mapping wiring diagram of the entire brain, the connectome, is the basis for understanding how genes and circuits control neural activities to orchestrate complex animal behaviors [1, 2]. A formidable challenge is to integrate multiple scales of imaging data on the structure and activity of numerous individual neurons with tiny fibers extending widely within an opaque brain [3]. This task has been largely overcome by several recent advances in innovative neurotechnologies such as tissue clearing methods for rendering the brain tissue transparent [4], super-resolution microscopy for visualizing synaptic structures, light-sheet microscopy for high-speed visualization of neural activities, non-linear image warping for data registration across different experiments and big data computation and 3D visualization. Here, we report an in situ brain imaging technique called Fly Head Array Slice Tomography (FHAST) to replace painstaking and inconsistent brain dissections for connectomics mapping in *Drosophila*. FHAST opens head capsules of an array of flies with a single vibratome section. Combining with deep tissue clearing, FHAST provides an in situ neuroanatomy of the brain with minimal structural distortion and enables automated large-scale imaging of 100 intact fly brains in each experiment. This standardized in situ brain imaging approach allows accurate registration of different brains into a common three-dimensional space for big data storage, search, sharing, analysis and visualization. The resulting connectivity matrix allows prediction of information flow from peripheral sensory organs to the whole fly brain.

REFERENCES


