Quantitative Cellular Neuroanatomy as the Foundation for Mapping Neural Circuits from Electron Microscopy

Albert Cardona

Janelia Research Campus, HHMI

***Abstract*— Mapping wiring diagrams from electron microscopy image volumes is hard. The task demands laborious proofreading by humans who resolve local ambiguities with larger contextual cues or by reconciling multiple independent reconstructions. We developed a new method that empowers expert neuroanatomists to apply quantitative arbor and network context to proofread and reconstruct neurons and circuits. We implemented our method in the web application CATMAID, supporting a group of world-wide collaborators to concurrently reconstruct neurons in the same circuit. The key finding central to our method is the developmental and physiological robustness in the synaptic connectivity between two neurons. This robustness originates in the spatial distribution of synapses over the postsynaptic arbor, which enable a strategy that avoids false positives and where false negatives do not alter qualitatively the recovered wiring diagram. Our findings are a foundation for developing machine learning approaches to mapping wiring diagrams**

***Index Terms*— cellular neuroanatomy, electron microscopy**