Computer Vision for Connectomics

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Abstract

Connectomics is an area of neuroscience aimed to discover the neuron shape and interconnections (neural network) within animal brain. A comprehensive knowledge of the biological neural network—often distilled from very detailed Electron Microscopic (EM) images of neural tissue—is critically important for a complete understanding of brain functionality. Recent advances in EM imaging have enabled us to capture the minuscule cellular processes at nanometer scale. However, such ultra-high resolution recording also produces a massive amount of data that must be analyzed to extract the neurons. Practical neural reconstruction approaches rely on computer vision algorithms such as segmentation and synaptic junction detection to perform this task. In this talk, I will describe the EM neural reconstruction framework that has been used at HHMI Janelia Research to reconstruct multiple neuropils of the fruit fly brain. I will also briefly mention how these reconstructions led to fundamental biological discoveries.

Bio

Toufiq Parag is a member of FlyEM team at Janelia Research Campus of Howard Hughes Medical Institute. As the computer vision expert in this group, he is primarily responsible for designing the segmentation algorithms that played the pivotal role in the reconstruction of several regions of fruit fly brain. Some biological findings from one of these reconstruction have recently been reported in PNAS. Some of the EM segmentation methods he developed at Janelia have been adopted by research groups at Harvard and MIT for their connectomics efforts. In addition to being published in the top vision/medical image processing conferences, his algorithms ranked high in the EM segmentation challenges. Before coming to Janelia, he was a grad student at the CBIM lab and completed his PhD in computer science in 2011 from Rutgers University under the supervision of Professor Ahmed Elgammal.
Faculty Host: Dimitris Metaxas