Defense Announcement

Variance Tensor Tractography for Densely Packed High-Throughput Microscopy Images

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Large-scale microscopy is an essential tool for improving diagnoses, and understanding the mechanisms of a large variety of diseases. However, data sets acquired using high-throughput imaging methods are extremely large and difficult to segment, analyze, and visualize. Automated methods for segmenting knife-edge scanning microscope (KESM) and serial electron microscopy (EM) images have met with limited success, largely due to data size and the complexity of tissue at the microscopic scale. In this thesis, we side-step this process by using a scalable visualization technique that extracts underlying features common in these data sets.

We propose the construction of a structure tensor field, which can be built out-of-core for large data sets. The processed data consists of a symmetric rank-2 tensor field describing the local structure of the data. This allows us to highlight two of the most common structures in dense microscopy images - surfaces and fibers. This tensor field is more robust to scaling than the raw image data, providing a method for scalable visualization. In addition we can use traditional visualization methods, such as tractography, to trace fiber tracts that have thus far been difficult to visualize and impossible to segment using more quantitative approaches. We propose the use of this technique for locating and selecting regions of interest that can undergo quantitative processing using practical data sizes that are amenable to rigorous analysis.