Visualization of Large Scale Microscopy Data

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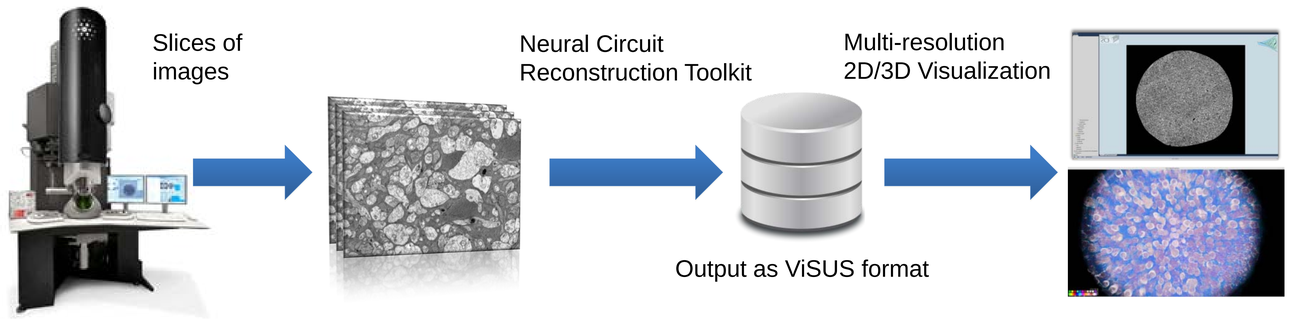
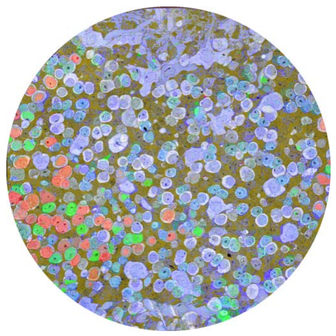
Data Acquisition:
Automated Transmission Electron Microscope (ATEM) imaging

Data is generated using Transmission Electron Microscopy. For each slice a mosaic of images is aligned and a slice-to-slice image warp is computed using the ir-tools from the Neural Circuit Reconstruction Toolkit. The ir-tools were extended to write directly to ViSUS ".idx" format which enable an efficient multi-resolution access for 2D/3D visualization and analysis.

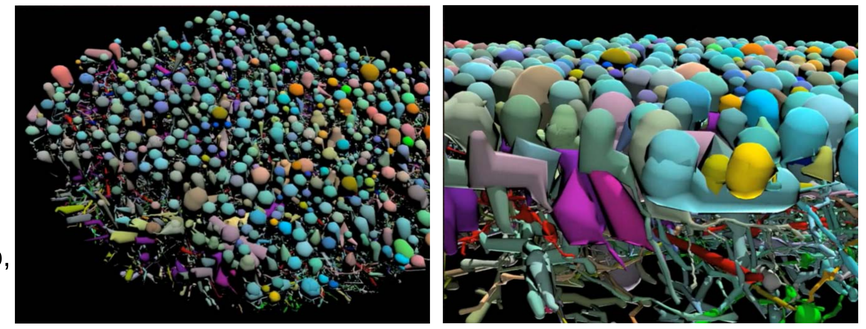




Rabbit Retina Dataset

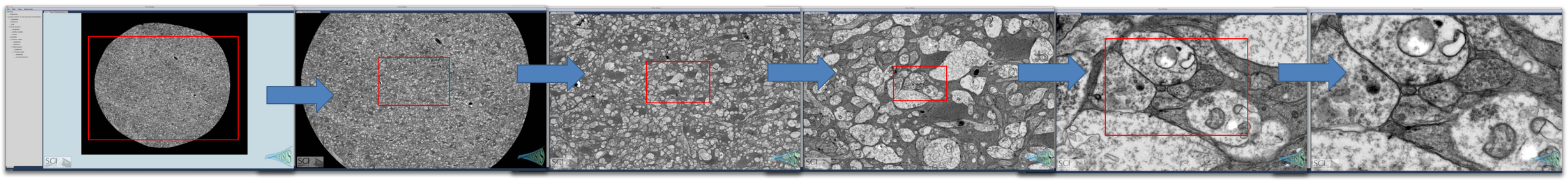
Connectome is a map of all the connections in the brain and retina. Making such maps is key to understanding our senses, thoughts, motions, emotions, and their disorders. Though such mapping is a grand challenge in science, anatomic tools have not been able to cope with the labyrinth of normal brain connections.

Electron microscopy has been the most powerful way to build minuscule brain map snippets. The Marclab in collaboration with teams at SCI Institute at University of Utah (and University of Colorado, Boulder) utilizing ATEM has completed the first connectome dataset: the retinal connectome for vision. The total dataset in idx format is 4.7 TB.



Manual annotation result of the Rabbit Retina Dataset

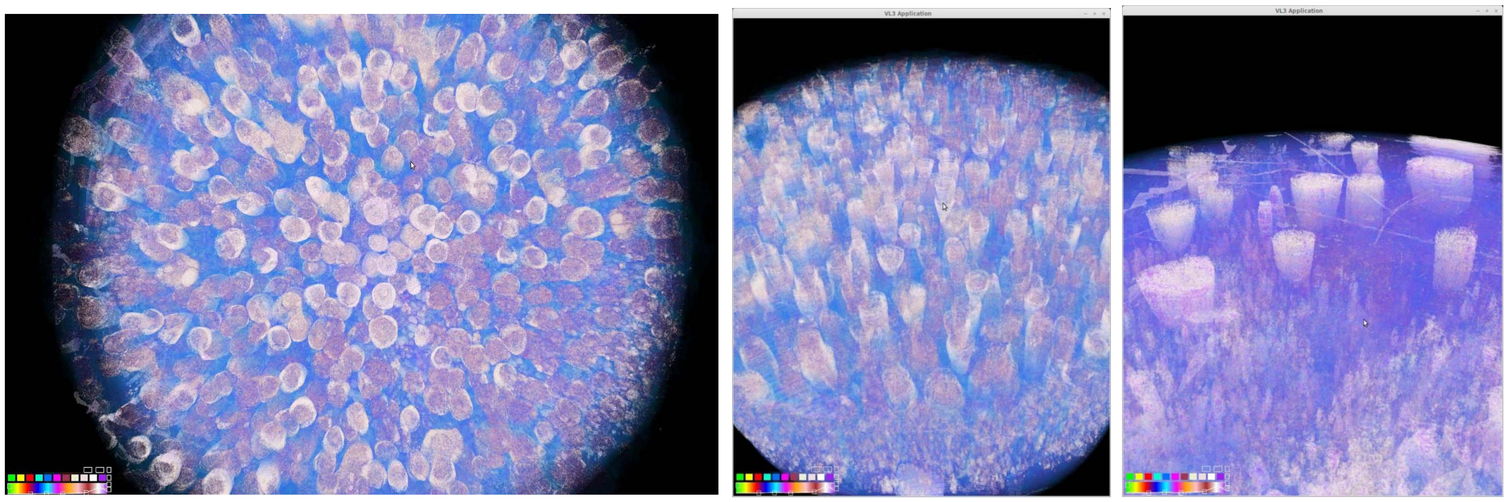
Multi-resolution 2D exploration in ViSUS Viewer



Visualization:
Slice-based 2D Exploration / 3D Volume Rendering

Multi-resolution 2D exploration in ViSUS Viewer is demonstrated by the sequence of images above. ViSUS's "idx" format and ViSUS Viewer enable interactive exploration of this extreme large scale (131071 x 131071 x 340) layered dataset.

The massive parallel volume rendering for the rabbit retina dataset is still a work in progress. The volume rendering result to the right is a relatively low resolution rendering (2048 x 2048 x 341) performed on a single GPU node. However, we can already see some interesting structures which are hard to recognize in the 2D view. Some of the major challenges of volume rendering this dataset, beside its 4.7TB size, are the lack of data in z axis (layers) and some major discrepancies between individual layers.



3D volume visualization in VL3 parallel volume rendering system

Automatic mosaicking and volume assembly for high-throughput serial-section transmission electron microscopy. Tasdizen T, Koshevoy P, Grimm BC, Anderson JR, Jones BW, Watt CB, Whitaker RT, Marc RE. J Neurosci Methods.
Global Static Indexing for Real-time Exploration of Very Large Regular Grids. V. Pascucci and R. J. Frank, Supercomputing 2001
MarcLab, http://prometheus.med.utah.edu/~marclab/

www.sci.utah.edu