BrainTrek: An Immersive Environment for Investigating Neuronal Tissue

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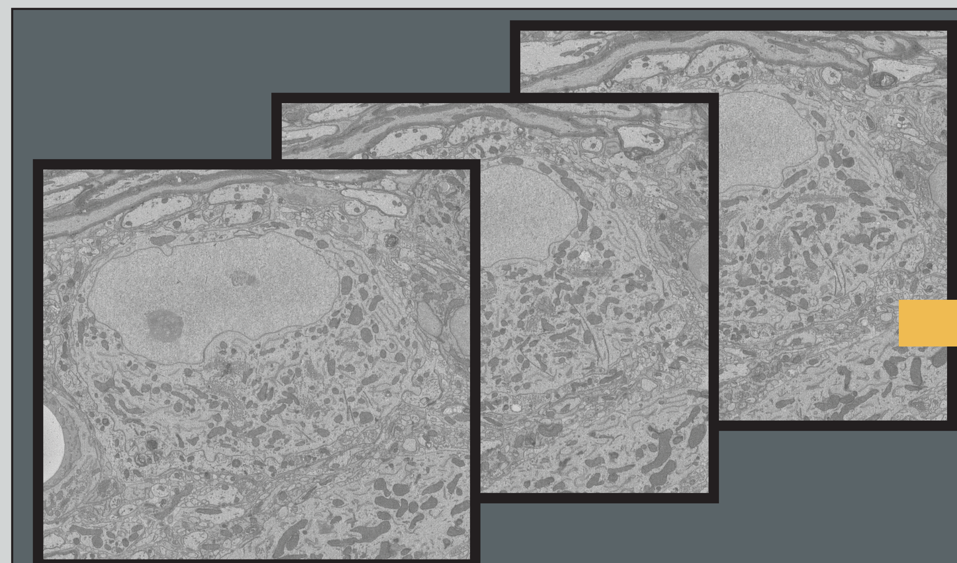
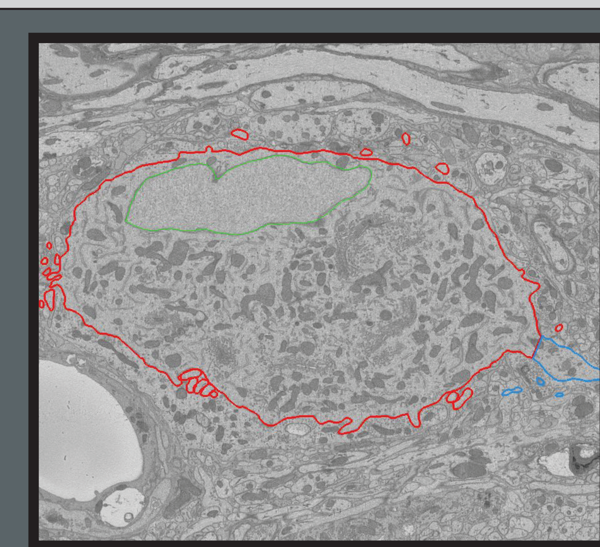
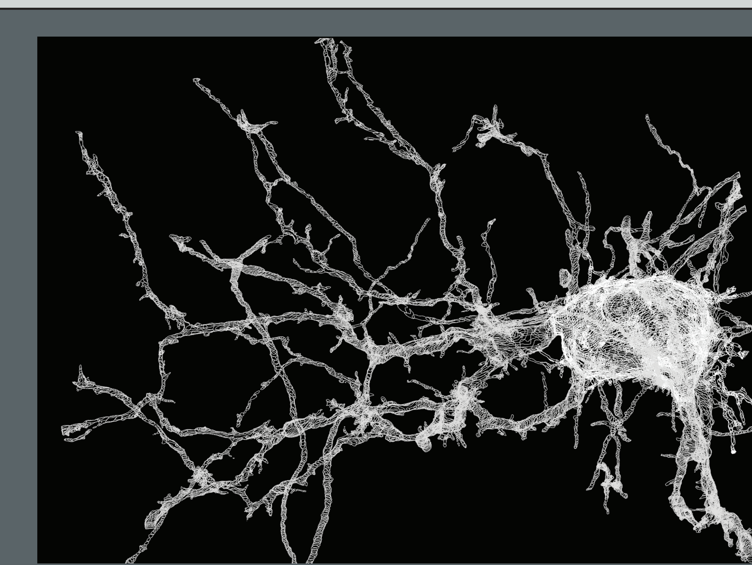


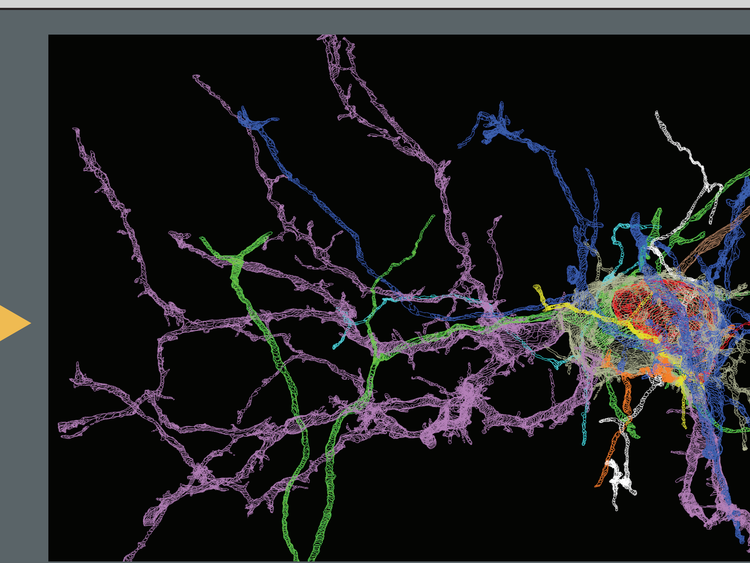
Imaging via SBFEMS



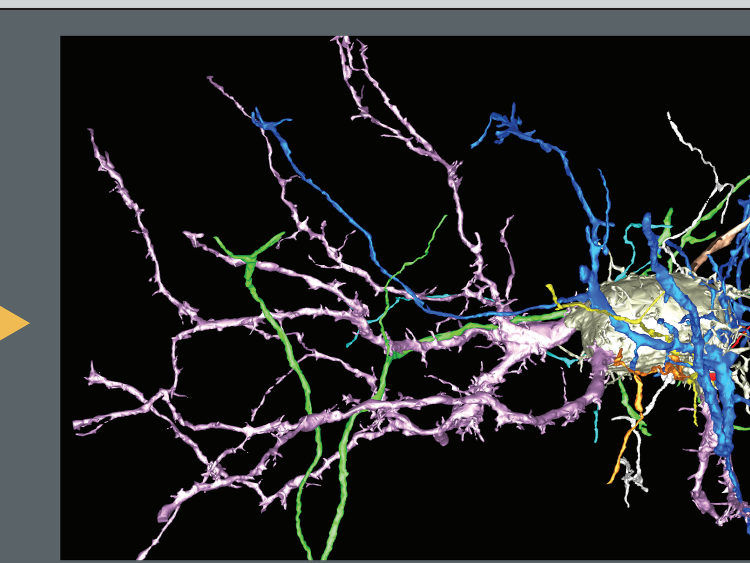
Manual Segmentation



Mesh Creation/Decimation

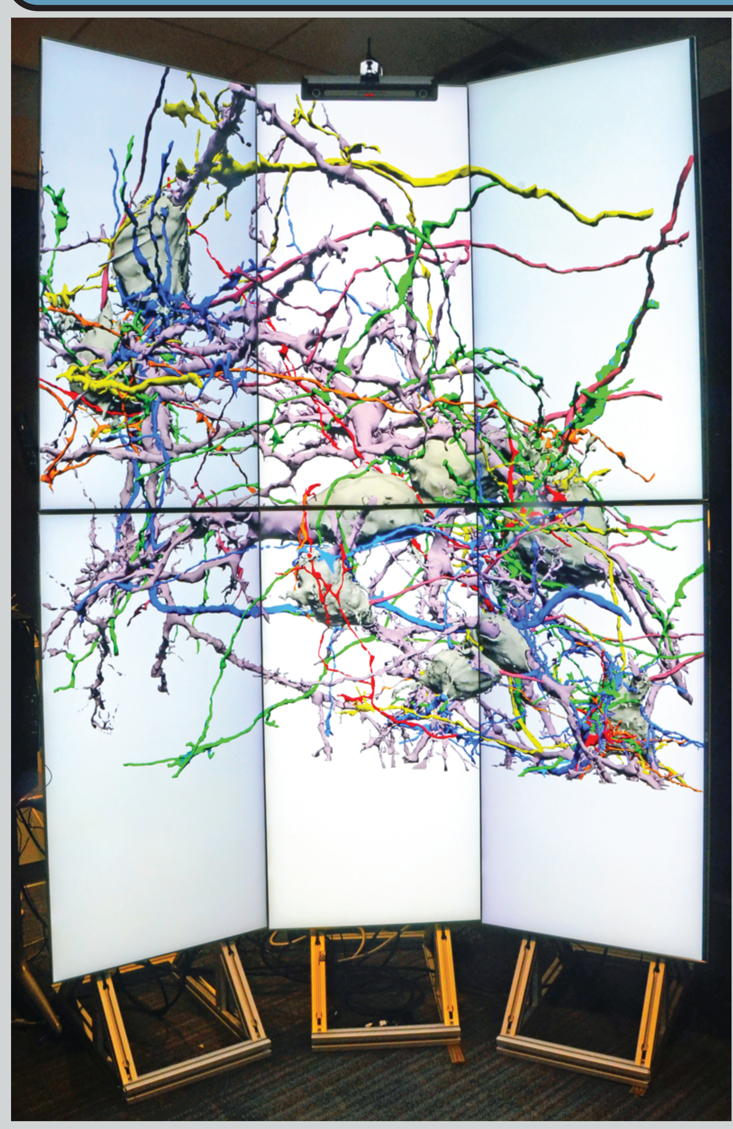


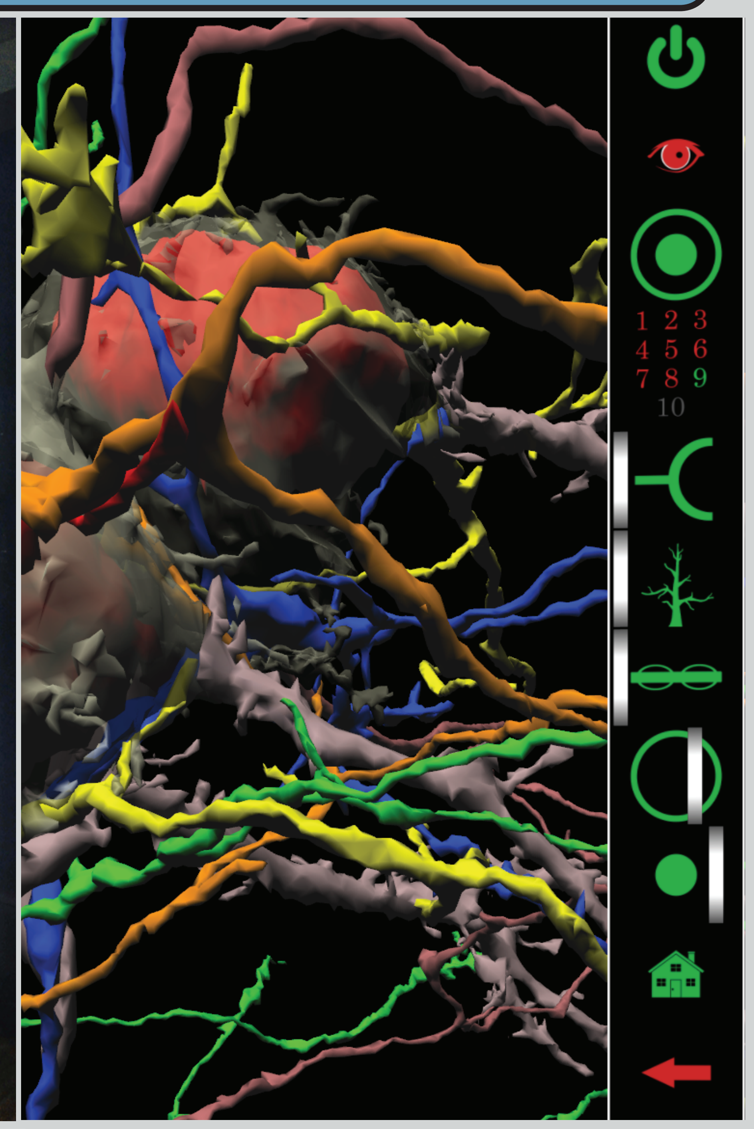
Part Splitting

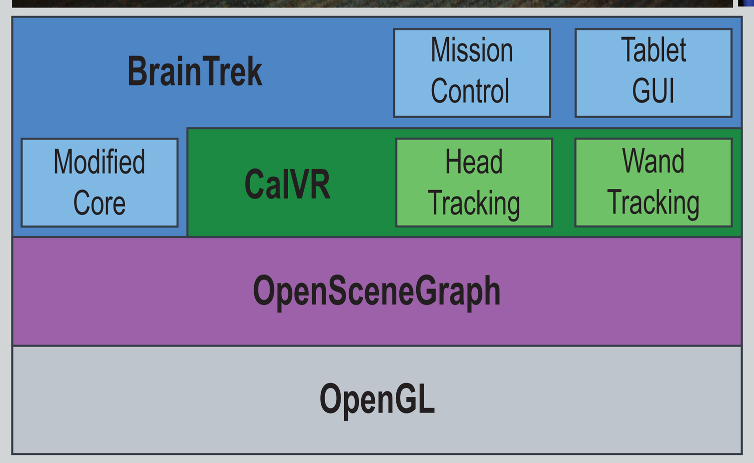


Load and View

BrainTrek Overview







Above: BrainTrek.
Above Left: A full view of the six 55-inch panel screens displaying nine complete cell models. The tracking system rests above the top middle panel.

Above Right: A close-up view of the BrainTrek system and on-screen menu. Two cells with different cell body transparencies reveal the contained nucleus (red) with varying clarity.

Above: BrainTrek architecture.
BrainTrek is a core modification of the 3D VR middleware, CalVR.
CalVR is built upon OpenScene Graph, an opensource toolkit for OpenGL. While BrainTrek leverages many innate features of CalVR (like head and wand tracking), direct modification of the core was necessary for neuron viewing.
A Java based Mission Control was designed for the fast management of cellular sets, and a novel tablet application was developed for controlling the system.

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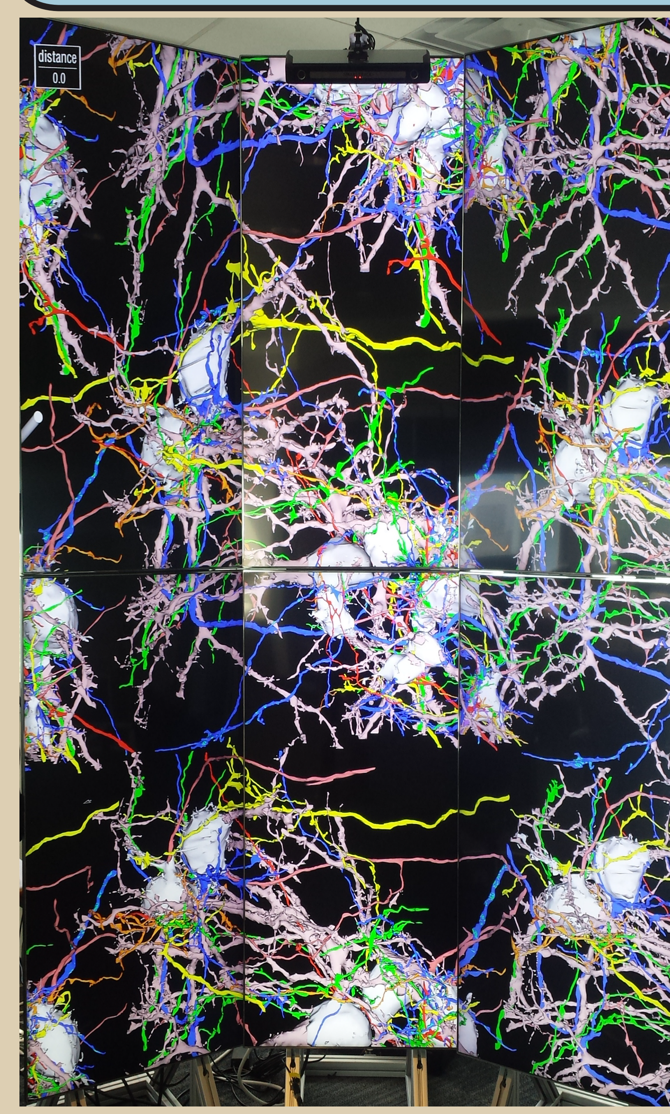
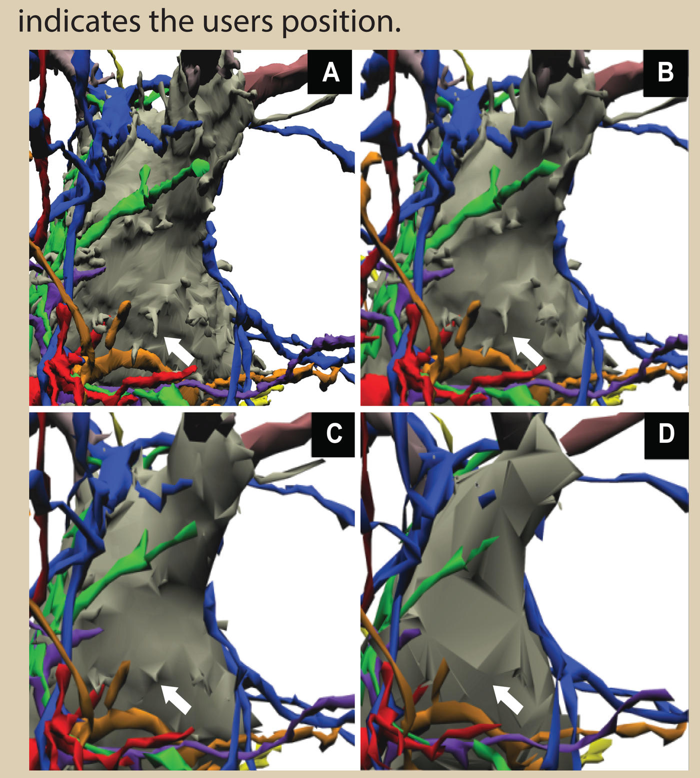
Visualizing Whole Volumes

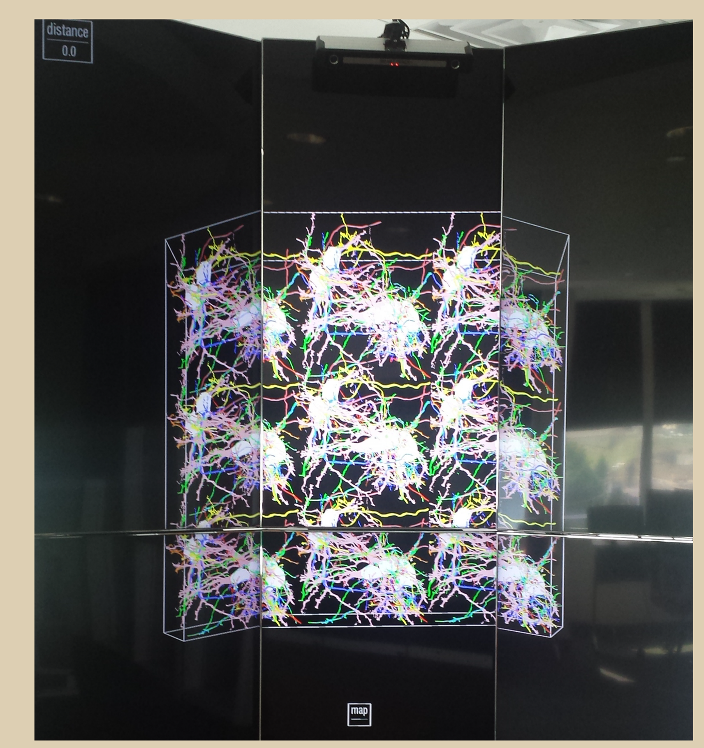


Left: With the use of two algorithms, Level of Detail and Culling Visitors, BrainTrek can handle large volumes of nervous tissue. 81 cells are shown.

Middle: An example of Level of Detail model resolution reduction. (A) Full resolution vertex density of 64 vertices/mm2. (B) At a vertex density of 8.2 vertices/mm2 (86% reduction). (C) At a density of 2.60 vertices/mm2 (96% reduction). (D) At a density of 1.48 vertices/mm2 (98% reduction).

Right: To help orientate users, an on-screen map can be toggled. A blinking red and green dot indicates the users position.

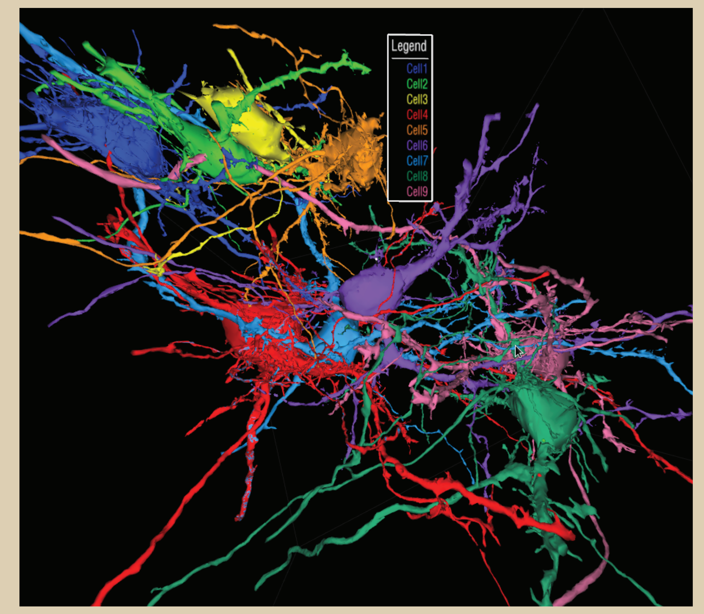


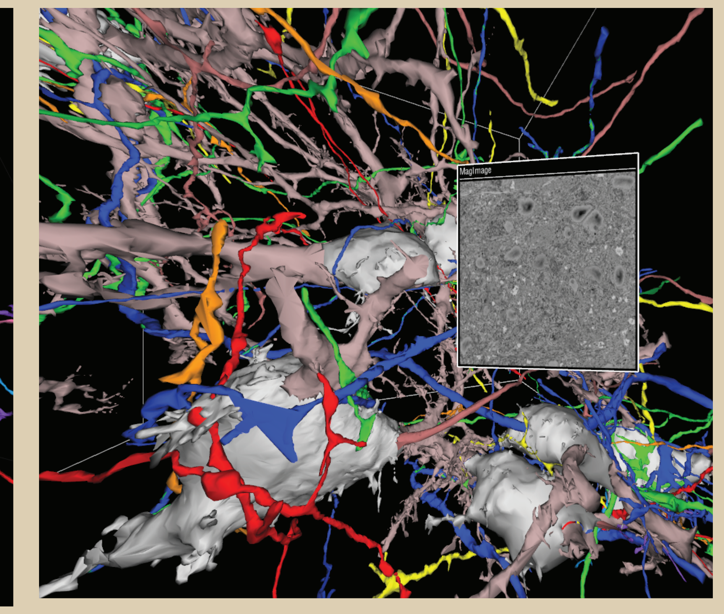


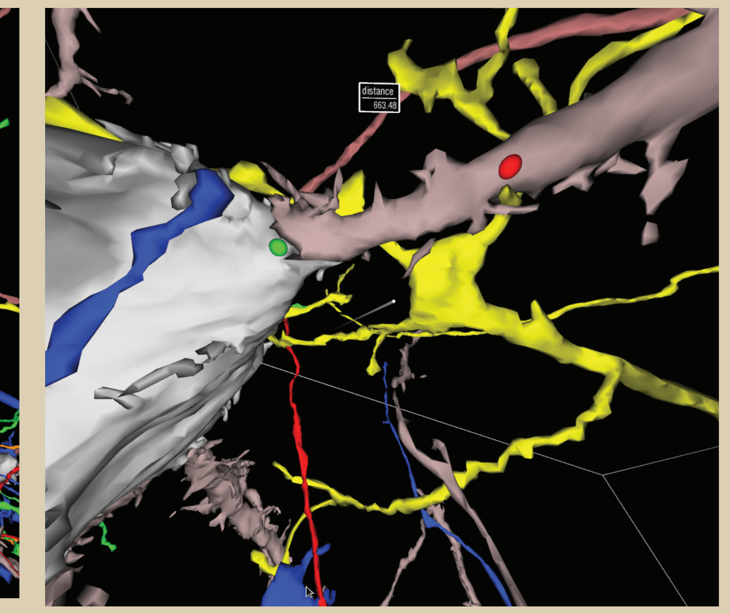
Bottom Left: To allow control of a subgroup of cells within a large field, a filter procedure has been implemented. Utilizing a nearest neighbor algorthim, the system locates the 10 closest cells. All others are filtered from view. Users may color-code cells to indicate the cell's identification number.

Bottom Middle: For streamlined microscopy exploration, users may request the electron microscopy image from which a particular voxel was extracted. This allows researchers to quickly inspect relevant non-segmented objects, such as synaptic vesicles.

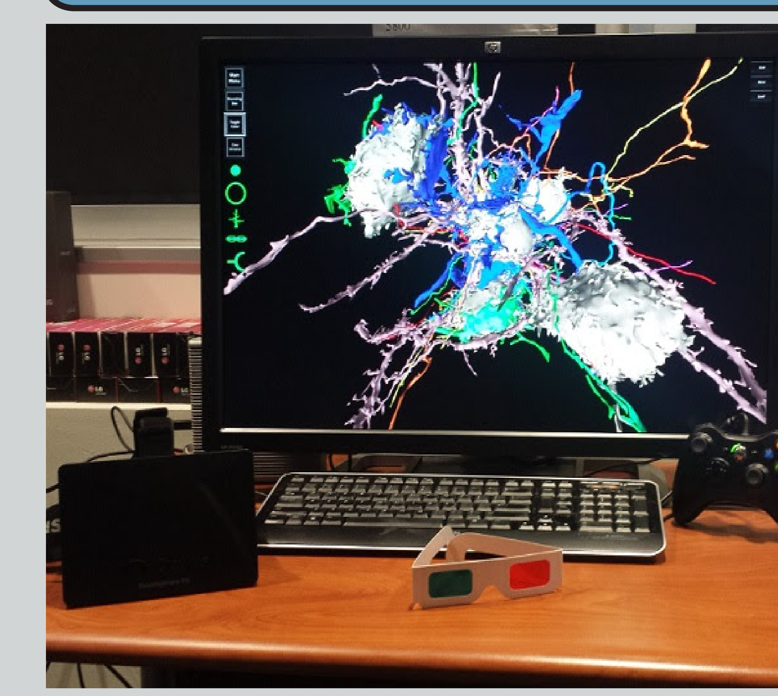
Bottom Right: Users can quickly measure objects in the system, by placing distance markers onto models. The Euclidean distance is calculated and presented to the user.







Single Screen BrainTrek



Top: The BrainTrek HMD system, with conventional monitor, Oculus Rift and anaglyphic glasses. An optional game controller is shown far right.

Below:
Top Left: An example of anaglypic viewing.

Top Right: Distance measurements can be made. A white line represents the distance.

Bottom Right: Utilization of the Oculus Rift. A user studies cells with 3D projection.

Bottom Left: The control schemes for keyboard and mouse, and the game controller.