Web Visualization of Massive Neuroscience Datasets using the Open Connectome Project

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Background

- Neuroscientists can now routinely collect **multi-terabyte** neuroimage datasets.
- **Visualizing** multi-terabyte datasets using traditional tools is limited.
- Sharing data with **collaborators** is inefficient and slow.

Challenge

- Traditional visualization tools require all rendered data to **fit in memory** before downsampling.
- **Sharing** interesting regions with collaborators requires mailing hard drives, loading specific sections of data, and recreating complicated procedures.
- Visualization **technique varies** between different data modalities.

Action

- We built an **open source Web viewer** that runs off the Open Connectome Project datastore.
- We enabled **seamless, incremental loading** of image data and labeled annotations with metadata support.
- We **integrated controls** for interacting with time series data and basic image processing.

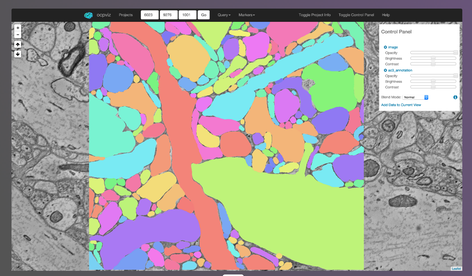
Resolution

- Anyone with **large neuroscience data** can visualize it in a web browser.
- Computer vision specialists can test different autosegmentation tools by **overlaying the results** immediately, without downloading.
- Collaborators can **share interesting data** regions by emailing Web URLs.

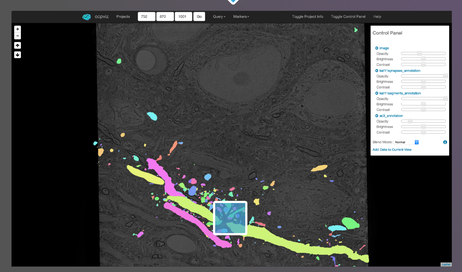
Background

- Modalities that now obtain terascale images:
  - Electron Microscopy
  - Array Tomography
  - CLARITY
  - Calcium Imaging
  - X-ray
  - Expansion Microscopy
  - Multimodal Magnetic Resonance Imaging
- Loading the entire dataset into memory to visualize using existing tools is hard.
- Downsampling a terascale image dataset aides in understanding where a specific object (e.g. cell) may be within the entire spatial domain (e.g. brain).
- Collaboration among neuroscientists and between neuroscience and other fields (e.g. computer science) requires the ability to quickly share data.
- Each data modality has specific requirements and may exist in multiple dimensions (e.g. time series data).
- Our viewer is focused on volumetric annotations, where CATMAID is focused on skeletons.

Challenge



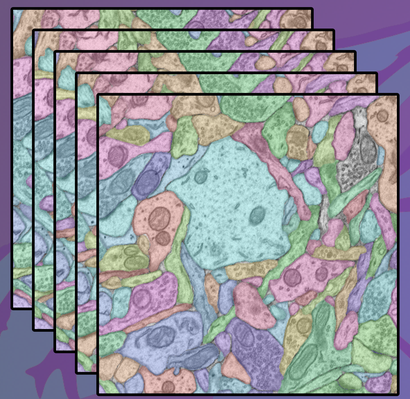
Dense Local Data



Sparse Global Data

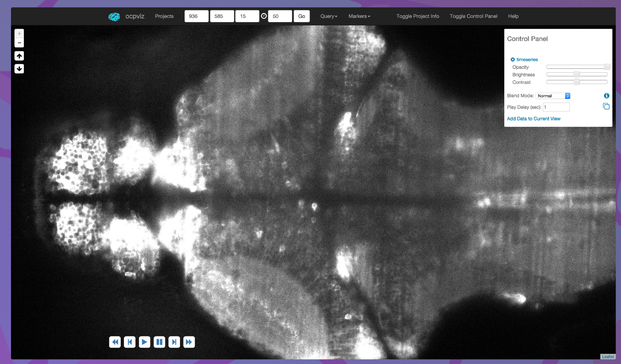
Action

Image Tiles



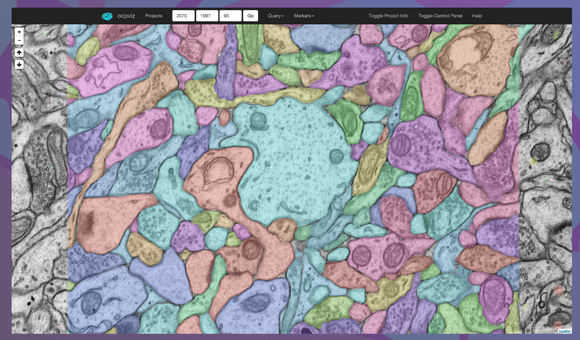
- Converted stitched, registered, and downsampled image data into a series of **image tiles**.
- Image tiles are typically 512 x 512 pixels.
- In ocpviz, image tiles are generated **dynamically** using the Open Connectome Project image database.

Time Series



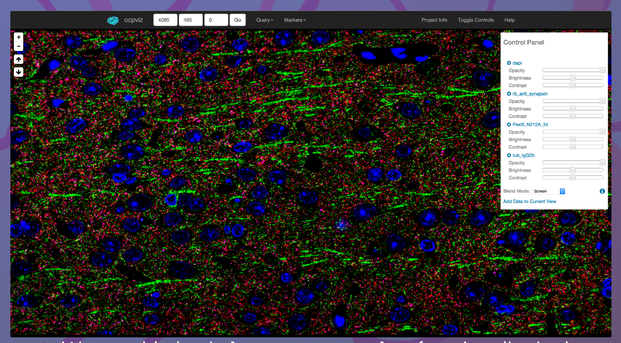
- We support image data formats from a wide range of modalities, including **8-bit and 16-bit images** and **32-bit images and annotations.**
- Multi-dimensional data is also supported (e.g. calcium imaging time series data, shown above).
- **Automated playback controls** were added to enable the user to create a short video with just a few clicks.

Web Viewer



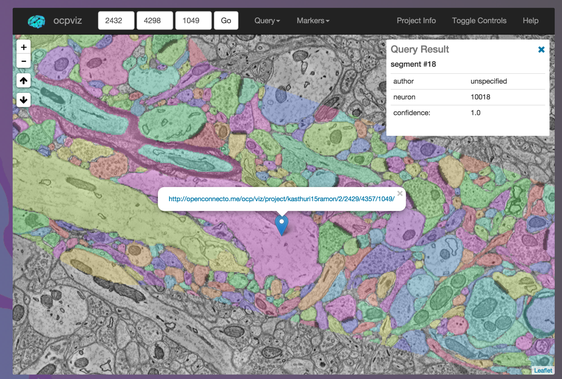
- Tiles are loaded dynamically using **LeafletJS.**
  - a lightweight javascript plugin built for **mapping.**
  - compatible with all modern web browsers
- We query the Open Connectome Datastore for **images and metadata**.
- We modified LeafletJS to **dynamically switch** between layers without interruption.

Image Processing



- We provide basic **image processing** functionality in the viewer.
  - Brightness and Contrast
  - Opacity Controls
  - Layer Blending Options
- Useful for **mutli-channel light microscopy** datasets (e.g. Array Tomography, shown above)

Resolution



- **Anyone** can visualize image data, view metadata, and share interesting regions with collaborators using a Web URL.

See ocpviz in action at Booth #2139!

References

[1]: LeafletJS: http://leafletjs.com
[2]: Saalfeld S, Cardona A, Hartenstein V, Tomančák P. CATMAID: collaborative annotation toolkit for massive amounts of image data, **Bioinformatics** 25(15), 2009.
[3]: Burns et al. The Open Connectome Project Data Cluster: Scalable Analysis and Vision for High-Throughput Neuroscience. **Sci Stat Database Manag** 2013.
[4]: Harris et al. A resource from 3D electron microscopy of hippocampal neuropil for user training and tool development. **Scientific Data** 2(150046), 2015.

Acknowledgements

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