Designing and Developing Automated Methods and User Interfaces to Enable High Quality Neural Connectivity Reconstruction From Electron Microscopy Data

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Introduction

Connectomics is a relatively new research field in which neural networks are reconstructed through brain imaging and complementary software. By creating a connectome, researchers are provided with a new insight to how neurons in the brain are wired and how they communicate with each other.

At the moment, the process of recreating the neural circuitry by manually tracing individual neurons is time consuming and vulnerable to human error. Automated methods are currently being developed to speed up the process and make it more accurate.

Activity

As the Saalfeld lab's research assistant, I was required to test out the tools and methods that my colleagues were developing to improve the accuracy of the automated tracing of neurons. This included manually proofreading smaller datasets that served as templates of the brain, where I focused on neuron segmentation, synaptic cleft annotation and synaptic partner identification. Those datasets were used in the Circuit Reconstruction from Electron Microscopy Images (CREMI) challenge at the Medical Image Computing and Computer Assisted Intervention Society (MICCAI).
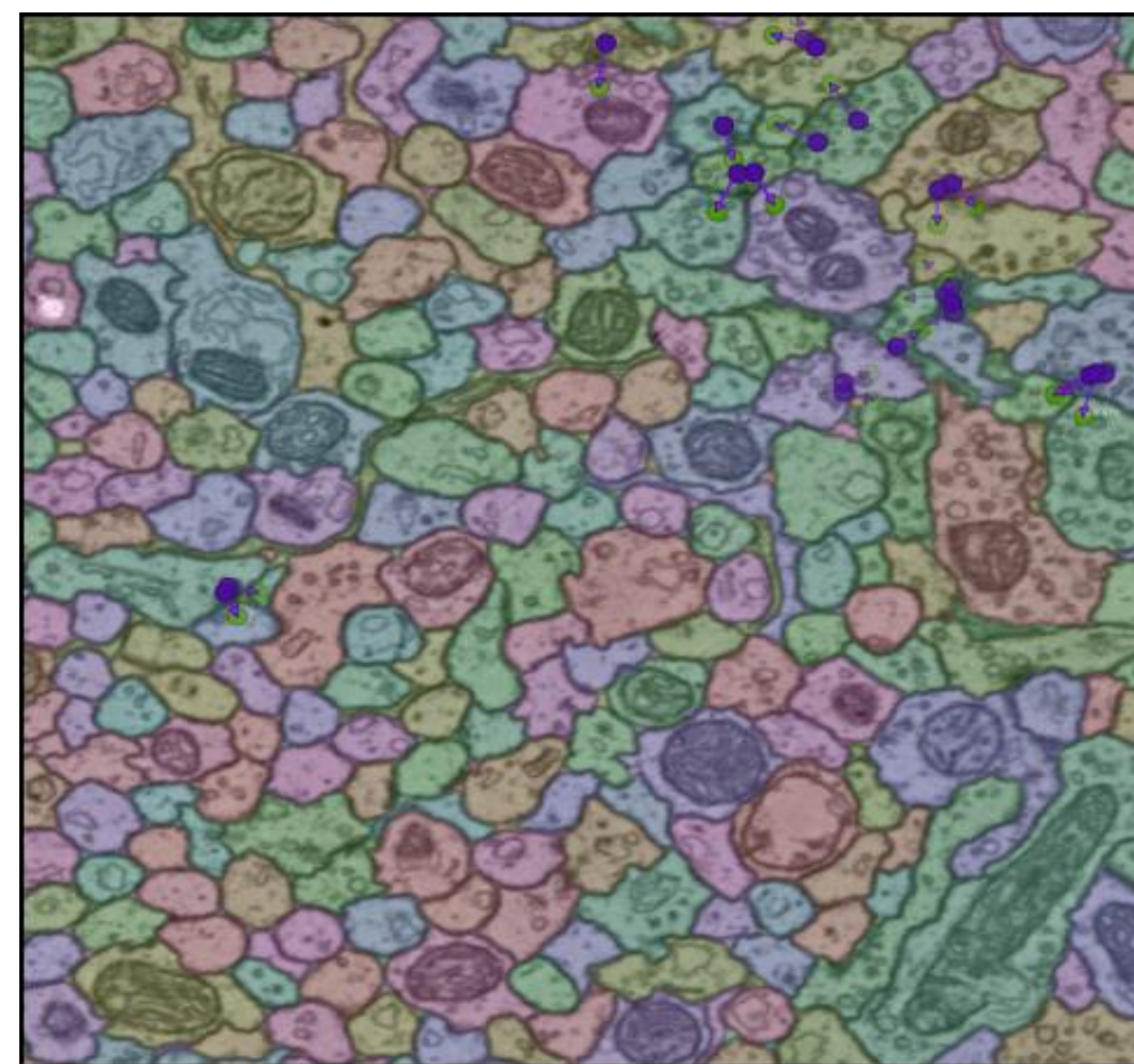
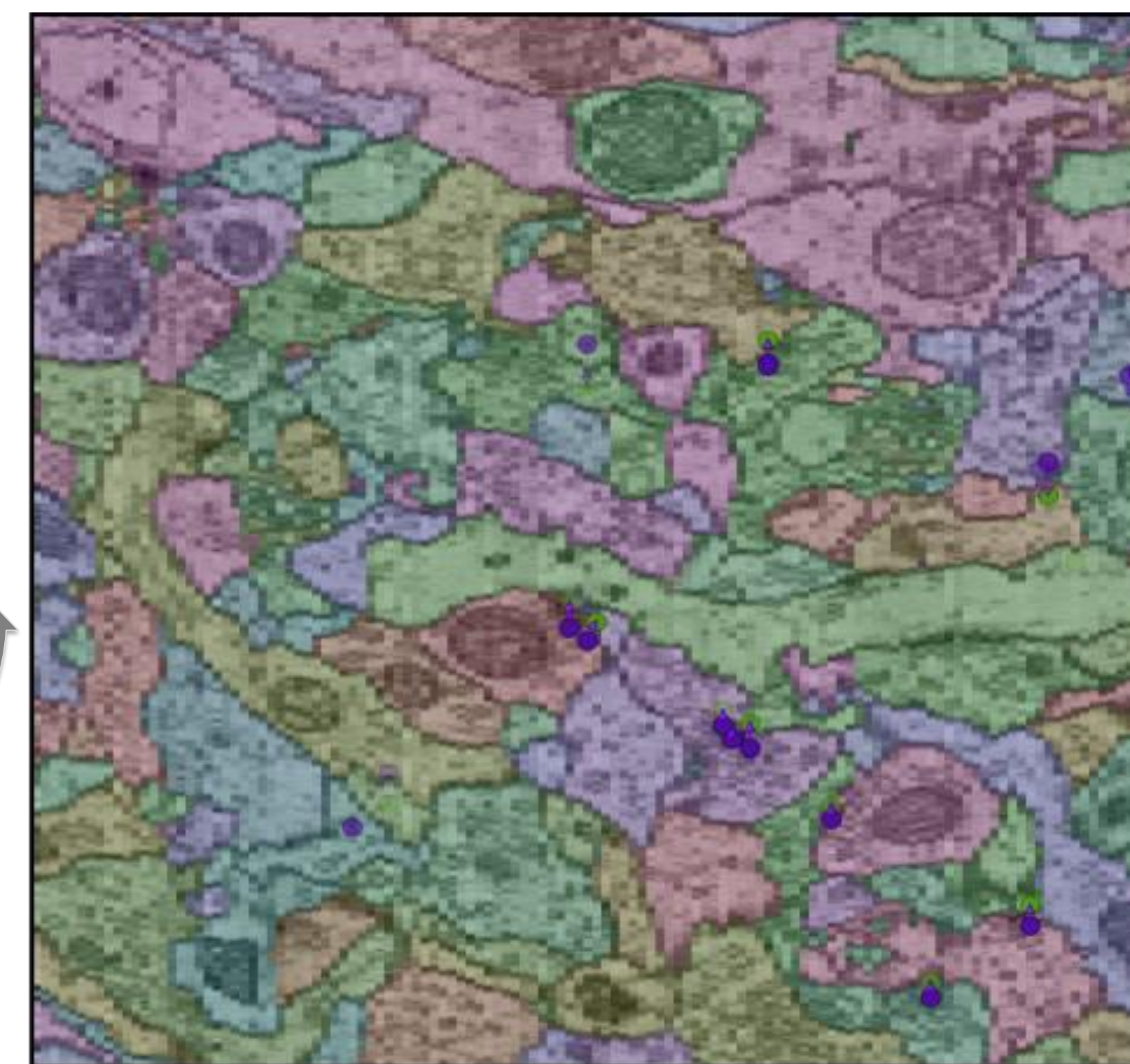## Results – data before and after running the reconstruction tool
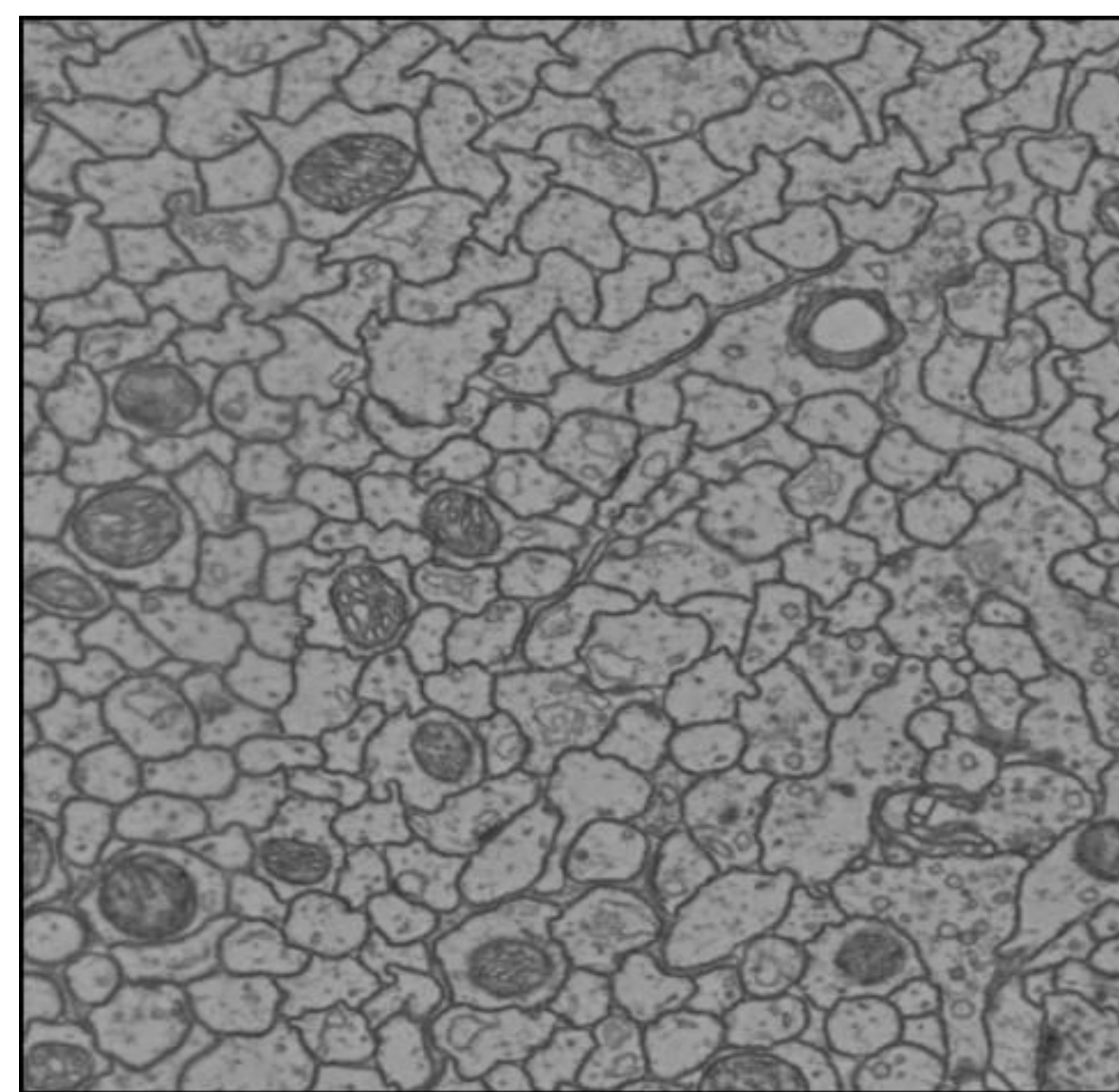
X-axis of *Drosophila melanogaster* brain cross section – unannotated
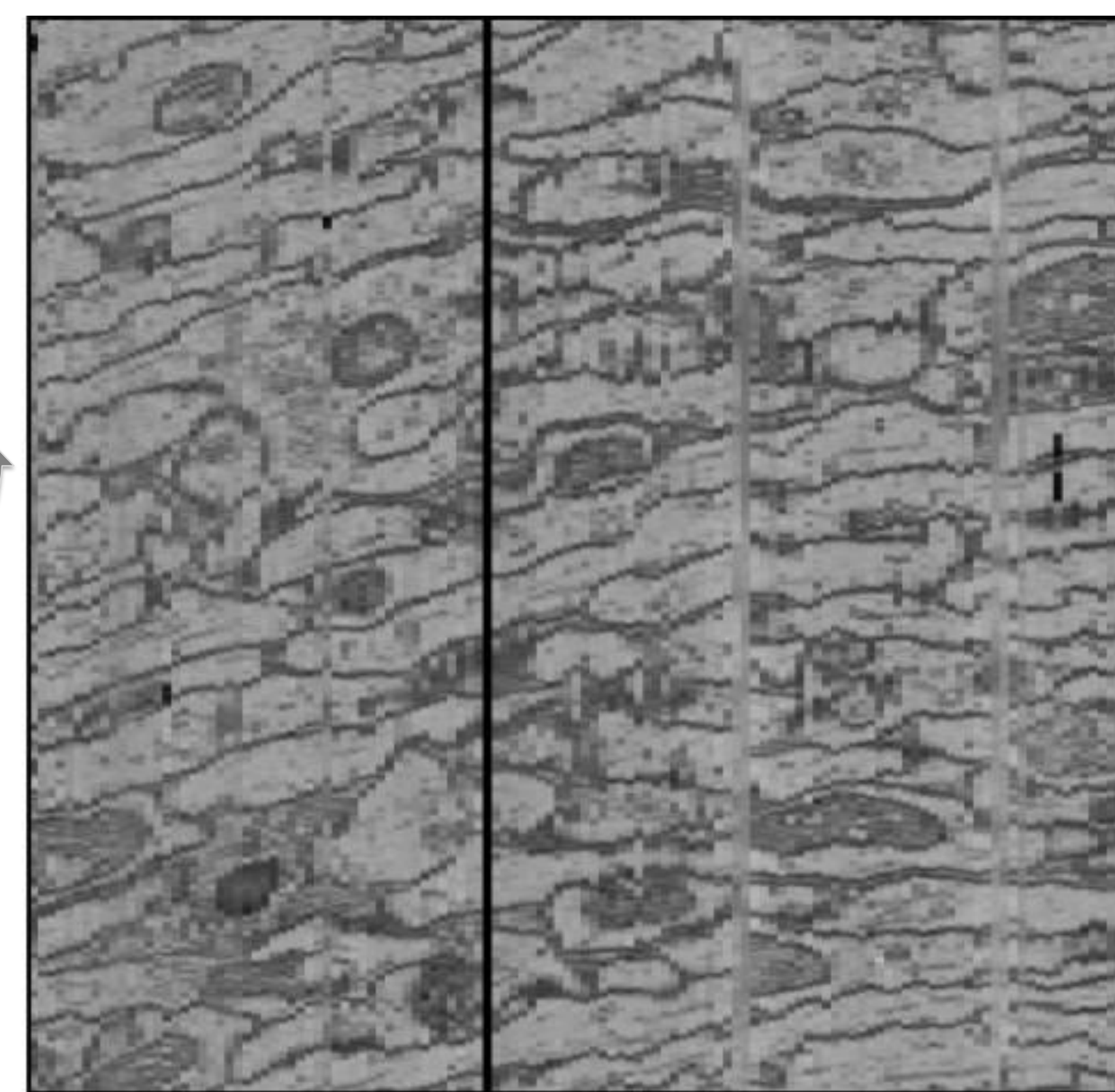
Y-axis of *Drosophila melanogaster* brain cross section – unannotated

X-axis of *Drosophila melanogaster* brain cross section – annotated, circles and arrows represent synapses

Y-axis of *Drosophila melanogaster* brain cross section – annotated, circles and arrows represent synapses

Outcomes

The CREMI Challenge was successful, with many submissions trying to come up with solutions that would allow accurate reconstruction based on my proofreading.

Reflection

After being introduced to the unlimited possibilities in computational neuroscience, I decided I would pursue a graduate degree in the field.

Although the results are still not at the 100% accuracy rate that we are thriving for, we are developing new methods to be able to achieve the goal of automating brain reconstruction.

Acknowledgments