

# Computational statistics for whole brain CLARITY analysis using the Open Connectome Project

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## Background

- ▶ The CLARITY brain clearing technique is a method for studying neurological diseases by observing structure [5].
- ▶ Neural activity is recorded via staining brains prior to conditioning

## Challenge

- ▶ Statistically differentiate between three classes of mouse brains

## Action

- ▶ Ingest data into the Open Connectome Project (OCP)
- ▶ Register & Align to the Allen Mouse Brain Atlas
- ▶ Compute Haralick Features for each Region of Interest
- ▶ Cluster & Evaluate Features via Adjusted Rand Index

## Resolution

- ▶ Demonstrated statistical differences between the various classes
- ▶ Small number of features (1-3) are sufficient for accurate classification

## Challenge



Figure 1. Goal is to differentiate between three types of conditioning. Source: Author

## Background

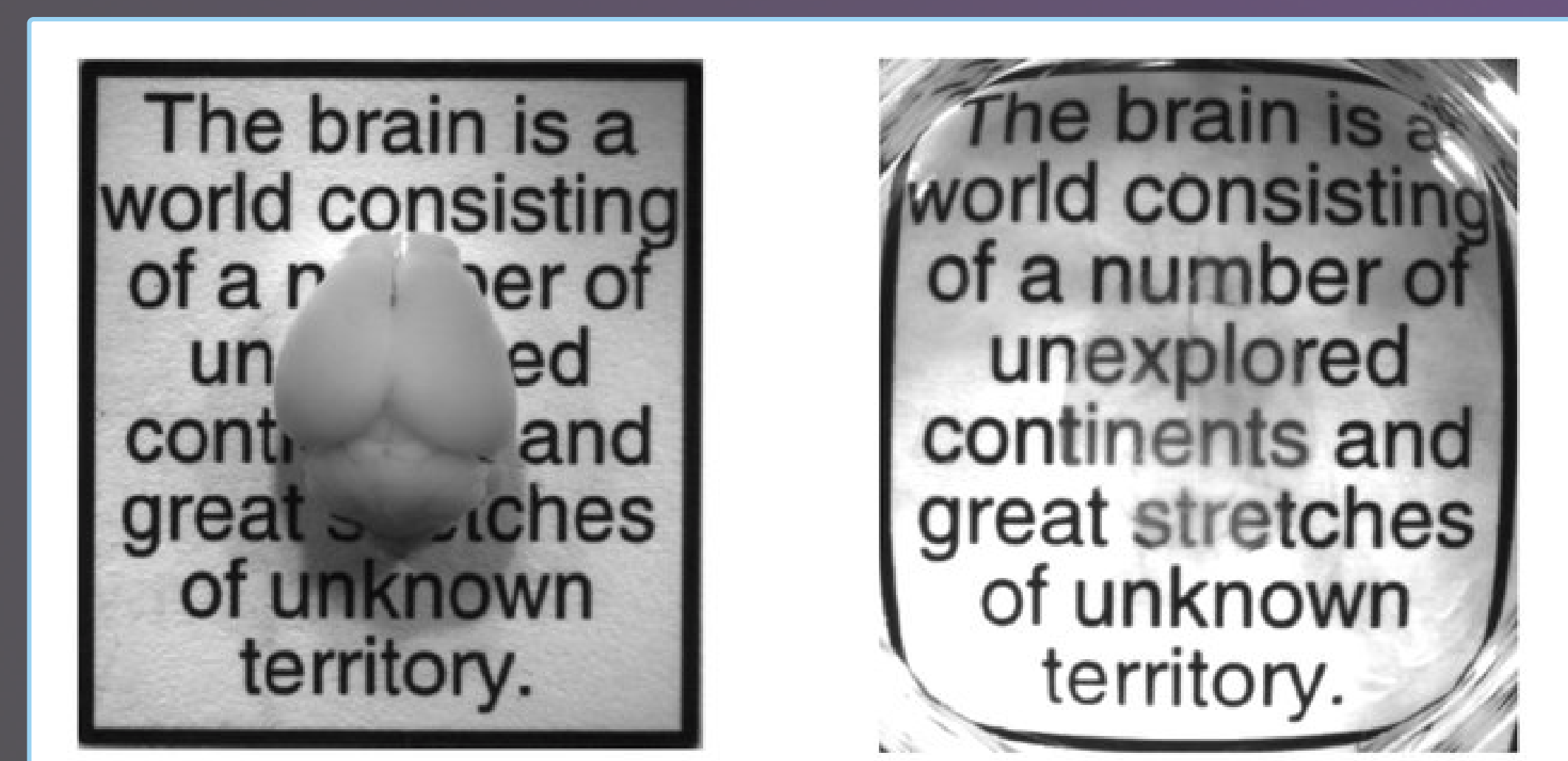


Figure 2. Effect of 'brain clearing' technique on a mouse brain. Source: New York Times

- After the clearing process, each volume is imaged using light sheet microscopy.

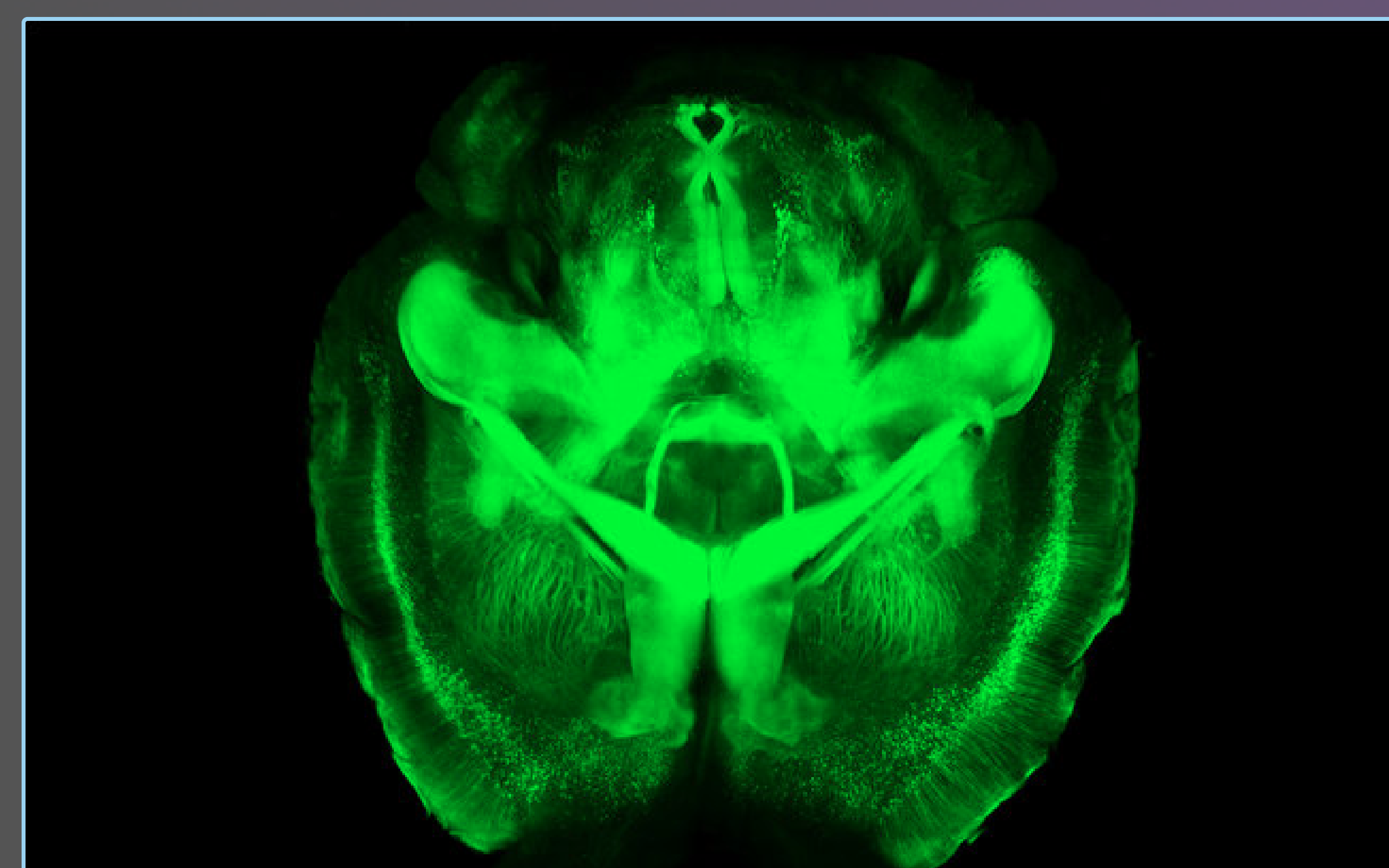


Figure 3. Mouse brain imaged with light sheet microscopy. Source: New York Times

## Ingest data into OCP Infrastructure

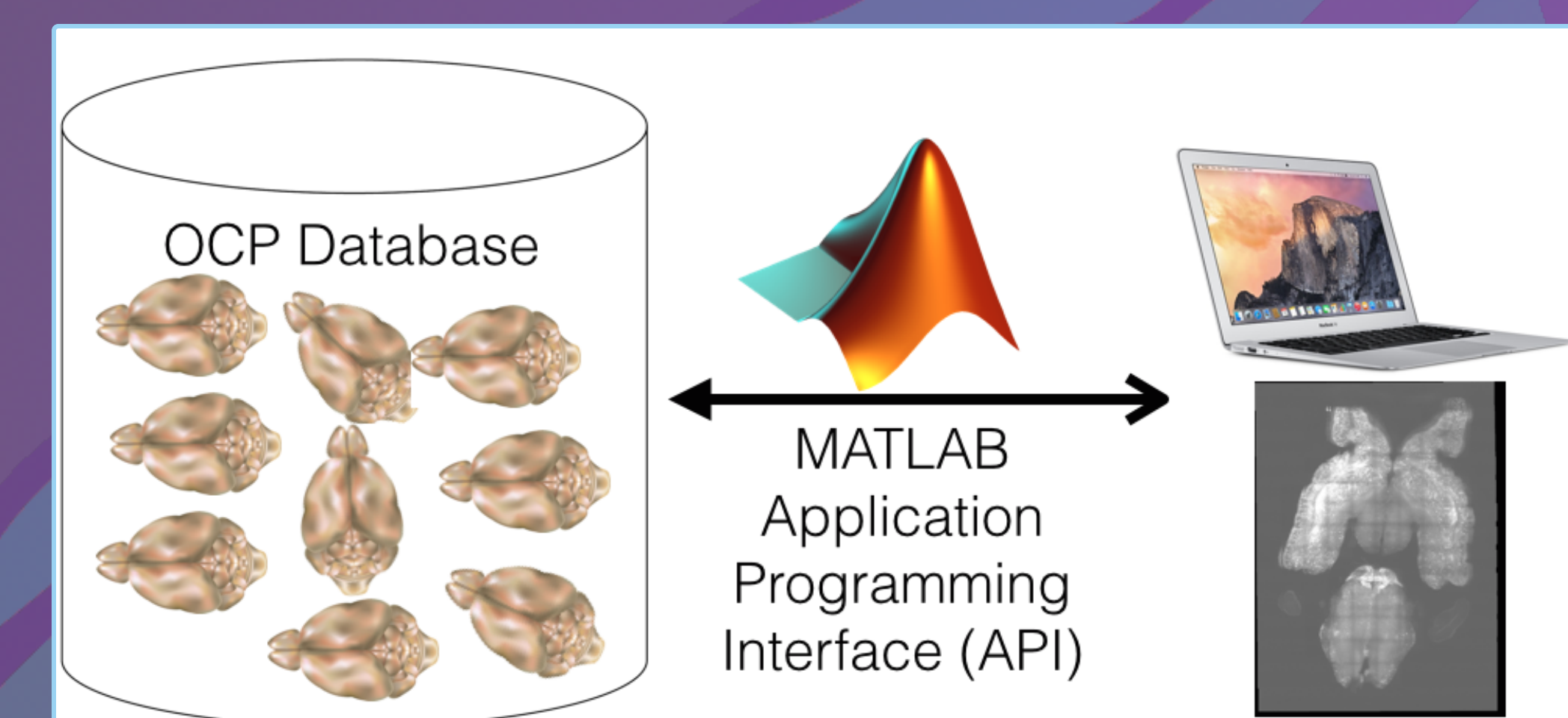


Figure 4. How OCP was used in this analysis. Source: Author

## Align volumes with Mouse Brain Atlas

- Each CLARITY volumes was aligned to the Allen Mouse Brain Atlas using non-linear transformations [4].

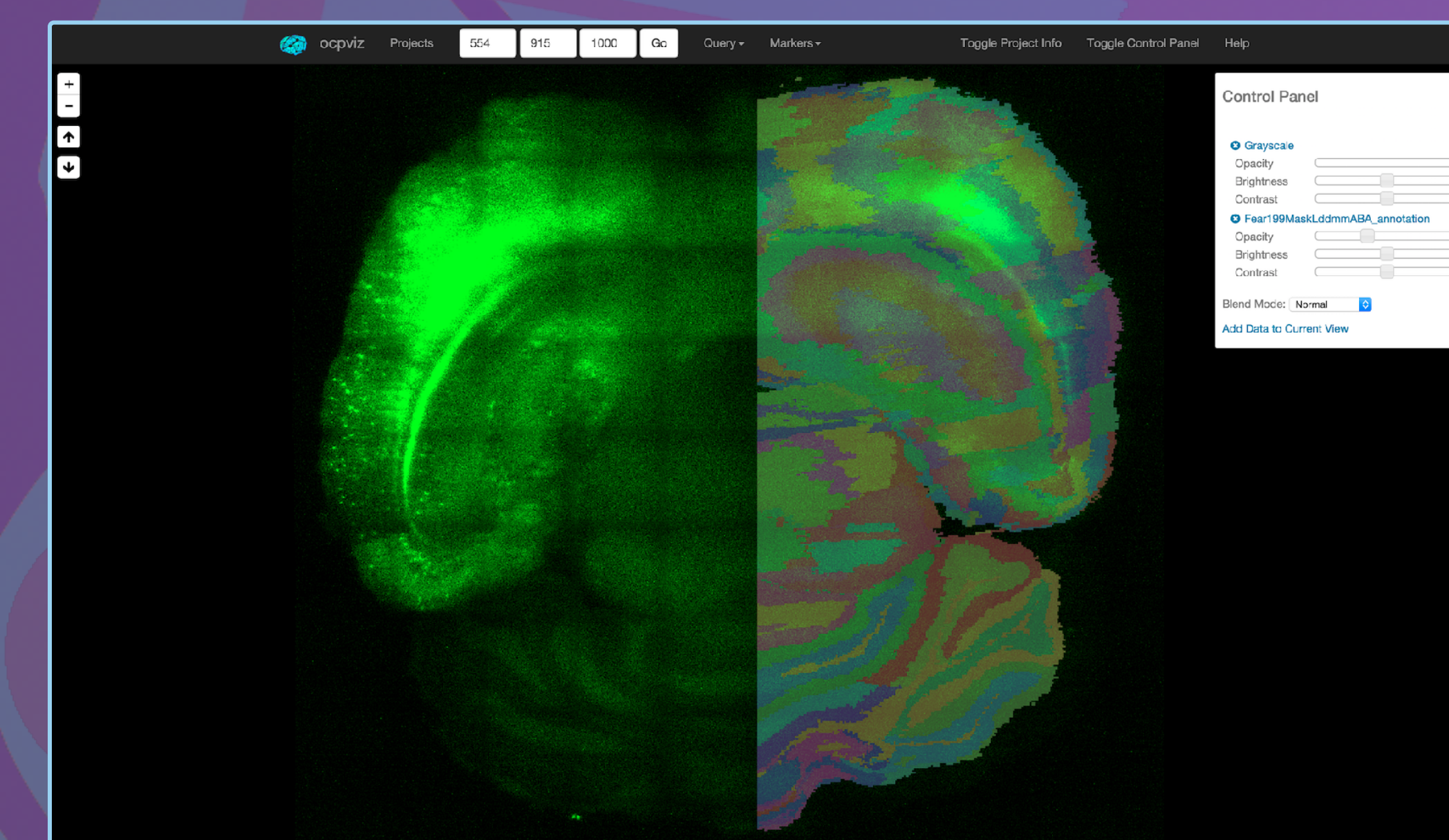


Figure 5. Image of mouse brain in native resolution (left) with Allen Brain Atlas registered, up-sampled, and overlaid (right). Source: Author

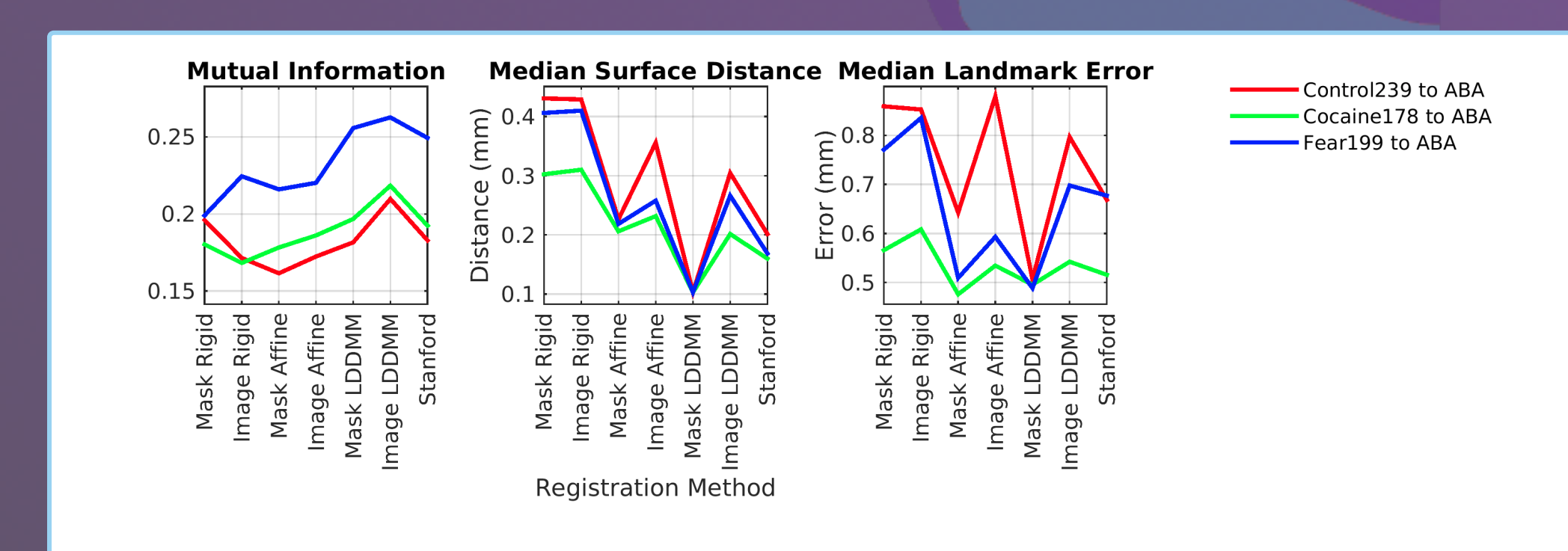


Figure 6. Metrics comparing CLARITY to ABA registration methods. Source: Author

## Action

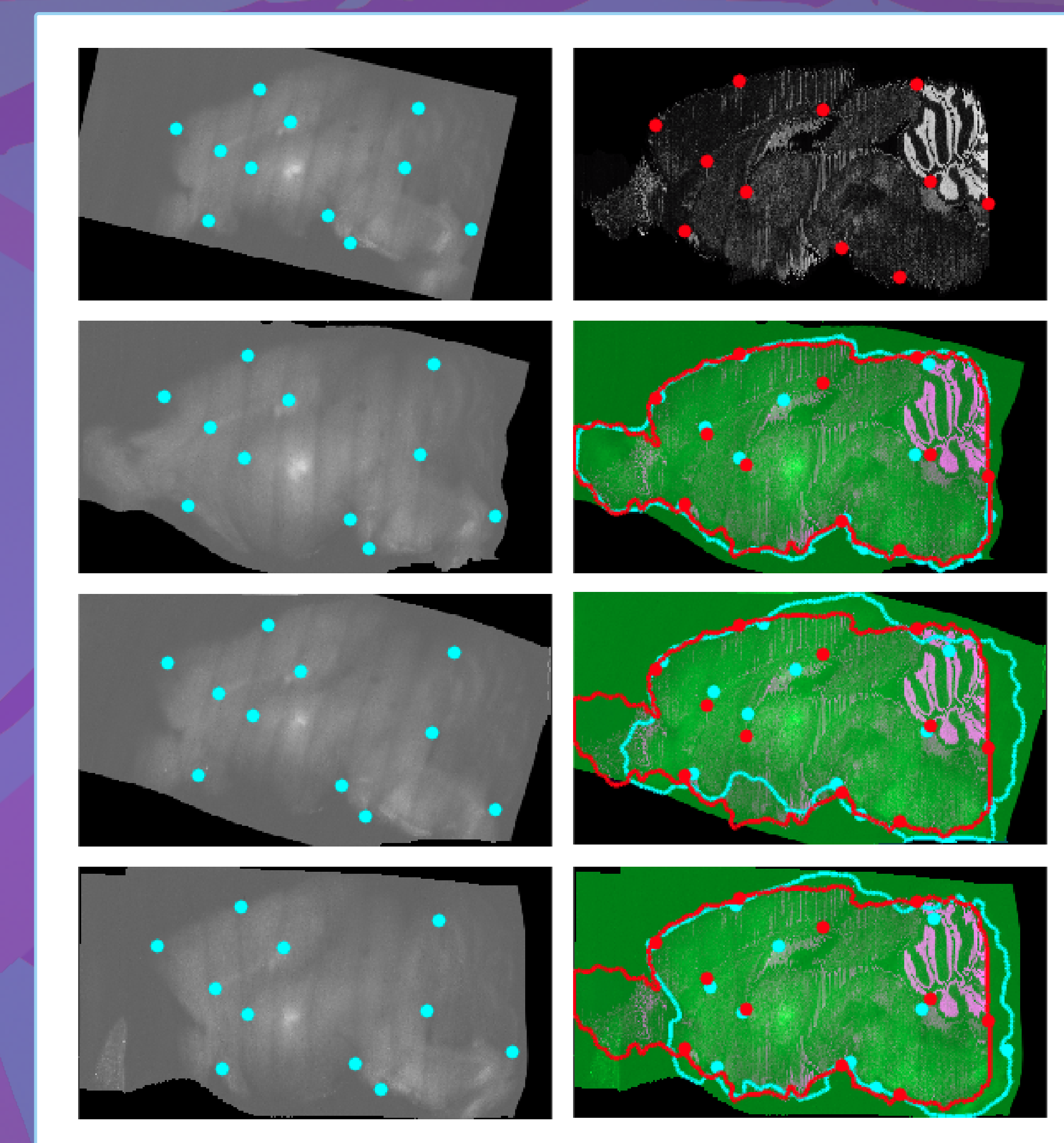


Figure 7. First row: CLARITY image before deformable registration and Allen Mouse Brain Atlas (ABA). Second, third and fourth rows: Registration results for Mask-LDDMM, Image-LDDMM and Stanford registration pipelines respectively. Source: Author

## Extract Features & Cluster

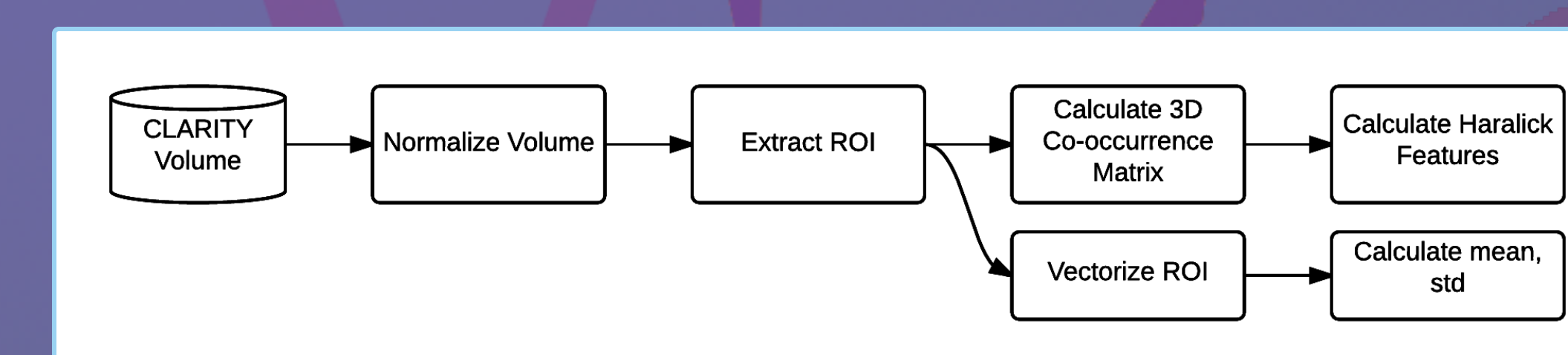


Figure 8. Feature Extraction Pipeline. Source: Author

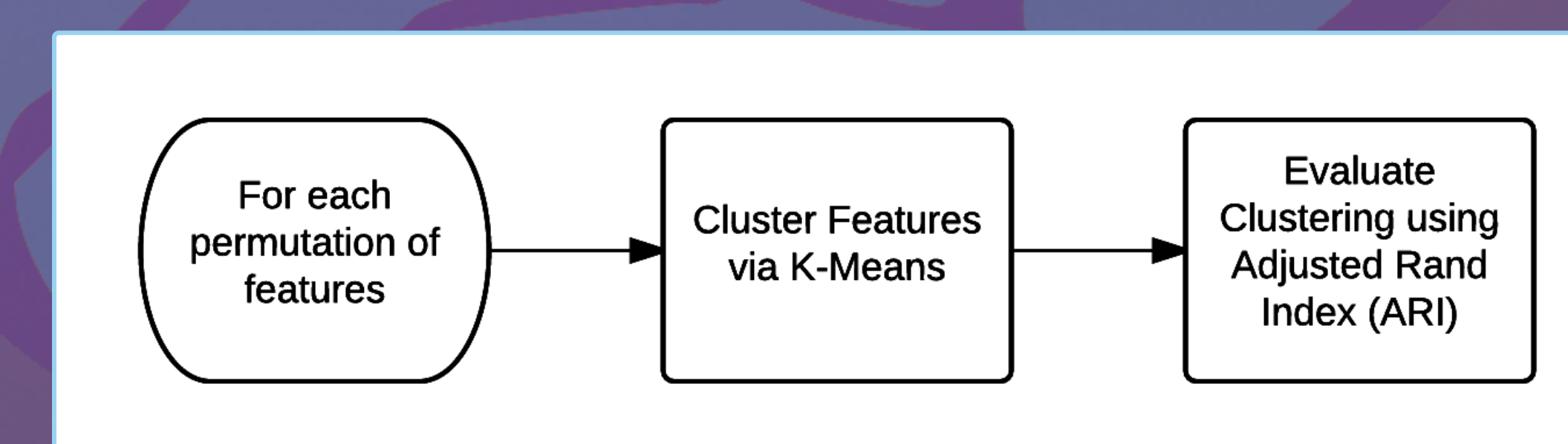


Figure 9. Clustering Pipeline. Source: Author

## Resolution

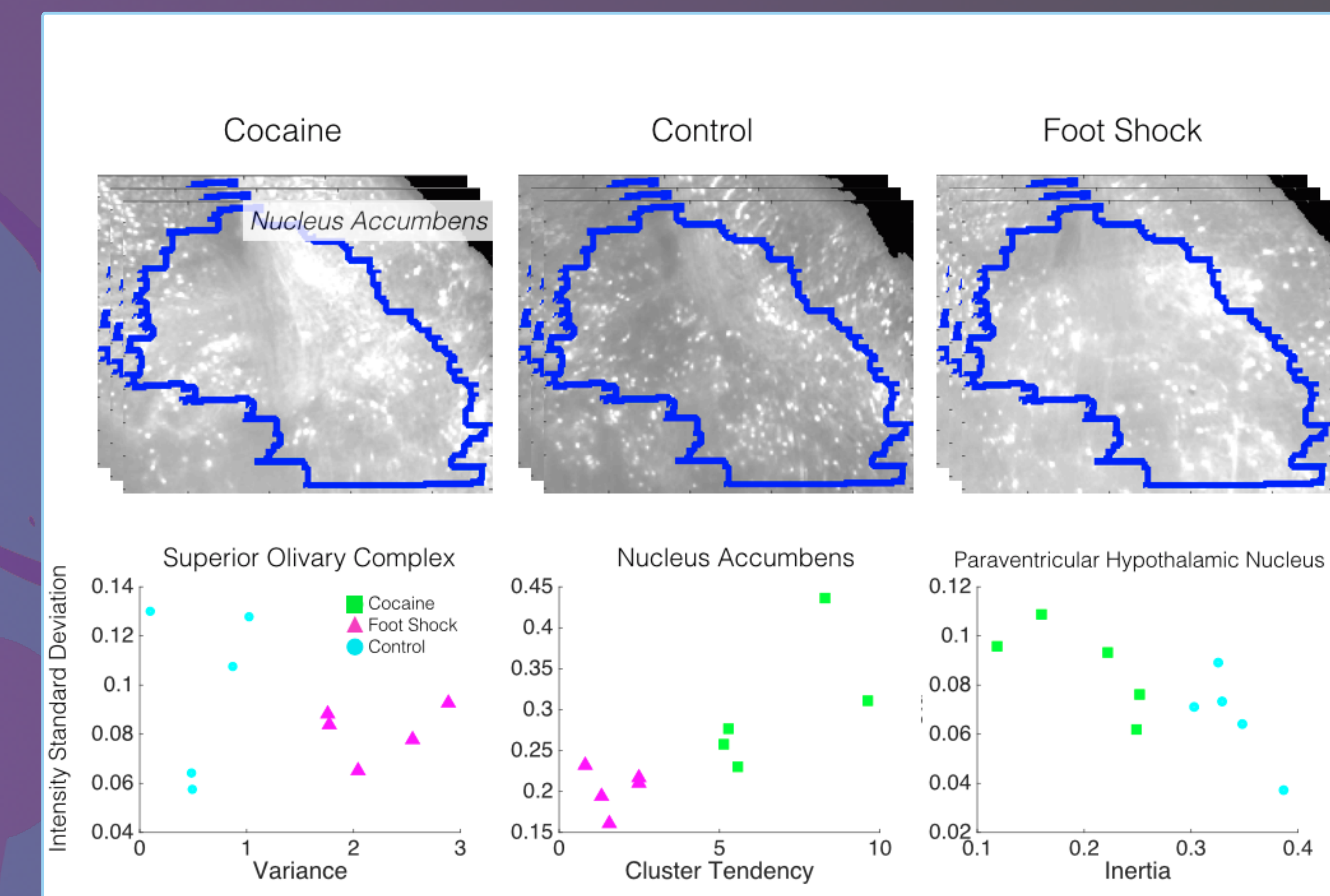


Figure 10. First row: Nucleus Accumbens under the 3 conditions. Second row: three pairwise comparison plots demonstrating accurate class separation. Source: Author

## References

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