



A3D3 Hackathon Neuroscience Group

High Throughput AI Methods and Infrastructure Workshop
July 14th, 2023

Group Members & Experts



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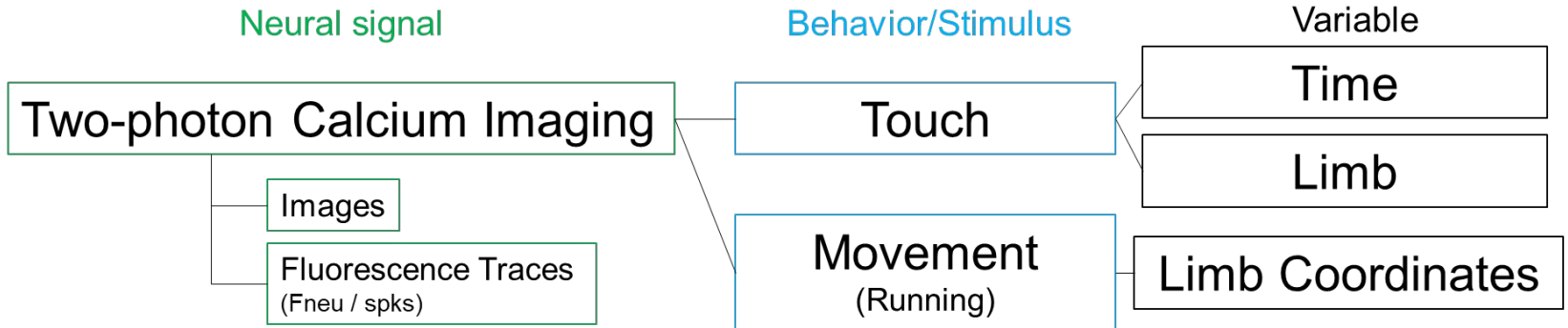
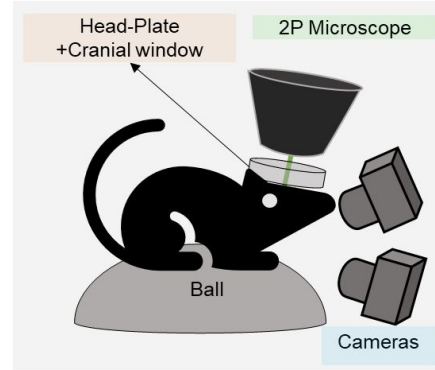
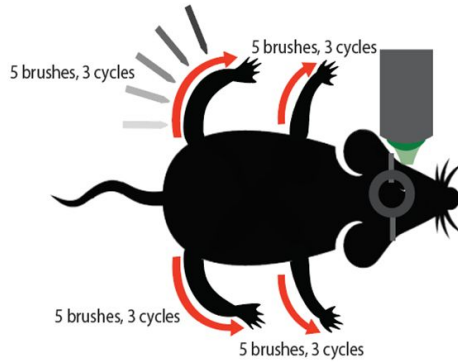


Maria Dadarlat
Neuro



Mia Liu
HEP

Introduction to Dataset



Strategy Outline

Tasks

- (1) Decoding
- (2) Reconstruction

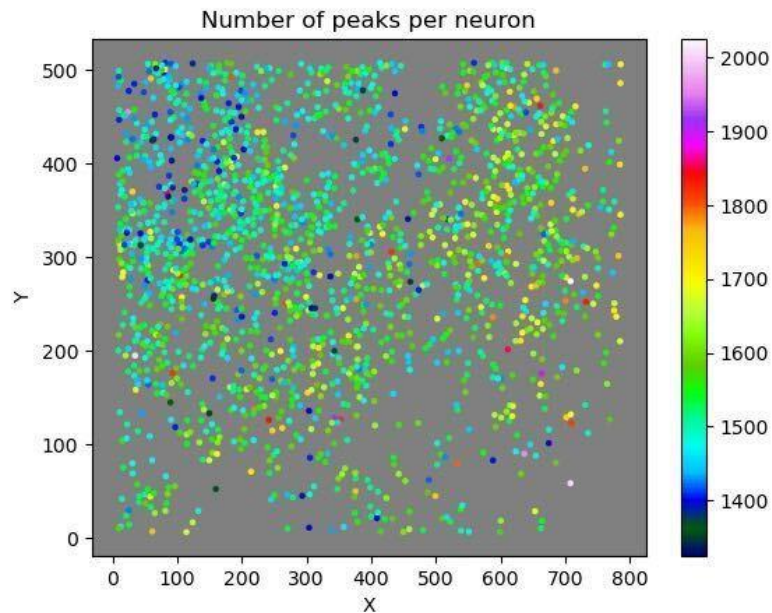
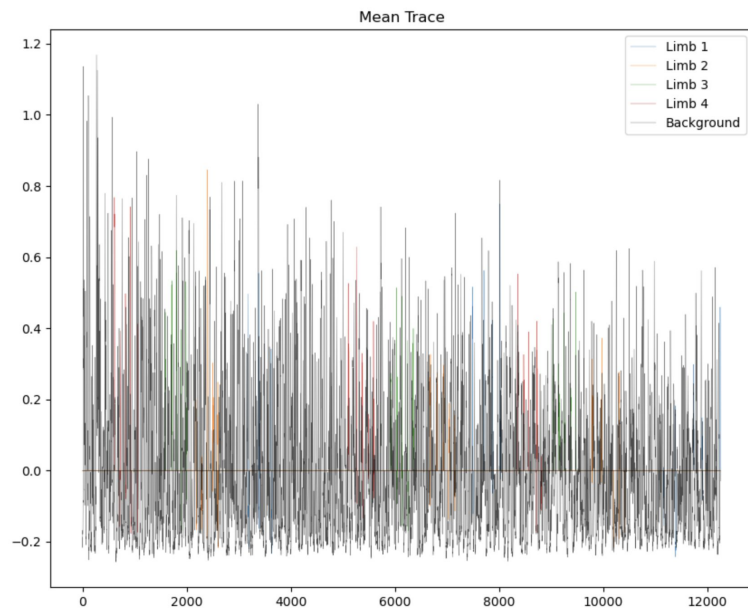
Goals

- (1) Increase accuracy in decoding/reconstruction
- (2) Modeling neural activity → to understand how neurons work

Approaches/Methods

- (1) Basic data exploration
- (2) GNN
- (3) Autoencoders, transformers

Idea #0: Data Exploration and Domain Learning



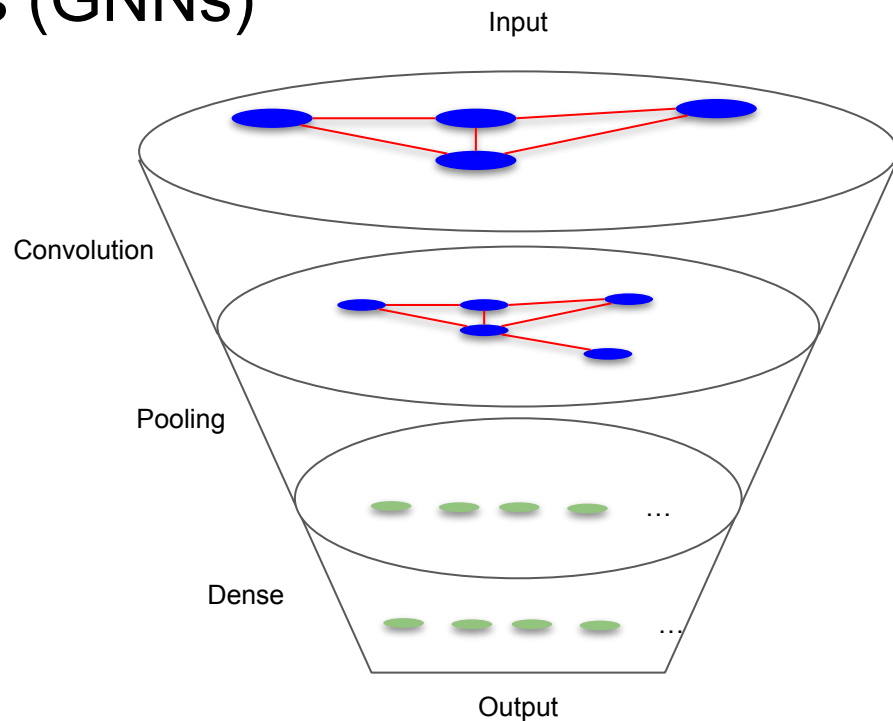
<https://academic.oup.com/bib/article/22/2/1577/6054827>

http://vpnl.stanford.edu/papers/kgs_etal_TICS.06.pdf

<https://suite2p.readthedocs.io/en/latest/FAQ.html>

Idea #1 Graph neural networks (GNNs)

- **Group Members:** Anthony Aportella (UCSD), Andrew Skivington (UCSD)
- **Goal:** To predict sensory state from brain's neural state
- **Strategy:**
 - Touch/limb classification
 - Preliminary graph convolutional net (GCN)
 - Input = graph of rat neurons
 - Output = limb prediction
 - Node features:
 - Absolute coordinates
 - Time series amplitude
 - Edge features:
 - Distance between nodes
 - "Activation" between nodes



Helpful links:

- <https://gnn.seas.upenn.edu/lecture-11/>
- <https://paperswithcode.com/paper/a-survey-on-graph-neural-networks-for-time>

- Debugging vanishing gradient problem with current architecture
 - Exploring GRNN
 - GRU vs LSTM GNNs

Idea #2 (Autoencoder/Transformer)

- **Group members:** Jack Rodgers, Will Benoit, Yichen Guo, Veronica Obute
- **Strategy:**
 - Transformer model that learns the neural structure of touch/proprioceptive stimuli. Could be extended to learn specific regions of the brain where response takes place
 - Autoencoder that learns the background, treat the problem like anomaly detection
 - Train/test both within each mouse and between mice to explore transferability of models
- **Progress:**
 - Processed/separated data into relevant formats for both transformer and autoencoder
 - Created initial outline of the transformer model architecture
- **Helpful links:**
 - <https://arxiv.org/abs/1706.03762>
 - <https://www.suite2p.org/>
 - <https://lilianweng.github.io/posts/2023-01-10-inference-optimization/>

Timeline & Long Term Goals

- Monthly zoom meetings to discuss progress with each topic
 - Highlight challenges and next steps
- Regular communication/updates in slack channel
- Test models on additional mouse data (n=6)
- Eventually test on running data?

