Steinmetz 2019 Data Notes for CSHL

Reference

*Distributed coding of choice, action and engagement across the mouse brain*

Steinmetz et al (2019)

https://www.nature.com/articles/s41586-019-1787-x

*Experiment*

They used high-density Neuropixels probes (2-3 per session per mouse over 2 to 5 sessions) to record from ~30,000 neurons in 10 mice while the mice compared visual contrast in two images and were supposed to turn a wheel right, left or neither. The task modulated activity of ~60% of recorded neurons, in nearly all 42 recorded brain regions.

They were able to assign about 22K of 30K neurons to specific regions, using the AIBS Atlas. They mostly focused on bulk activity, rather than co-activity.

Much of the paper contrasts brain-wide modulation of neural activity during active trials to more restricted changes during passive viewing of the same stimuli used. They also find mid-brain neurons are more strongly activated during contralateral choices, while forebrain neurons may go either way.

After 100-150 task trials, they let the animal rest for about 10 min and then intermixed passive visual stimuli and played three types of sounds for 12 minutes. They recorded licking behavior and classed several thousand times as licks.

Discrimination Trials

The mouse could start a trial by holding the wheel still for a short interval (0.2–0.5 s ). At trial start, visual stimuli appeared at the centre of the left and right screens, in the center of their visual field, directly left and right of the mouse.

The mice were supposed to turn the wheel to bring the higher contrast image toward the center; thus, they turned the wheel away from the higher contrast image. When both images had equal contrast, left and right turns were rewarded with 50% probability. When no stimuli were presented, the subject was rewarded if no turn was registered during the 1.5 s following the Go cue.

If the mouse responded correctly, a water reward (2–3 µl) was delivered by via the water tube for 1 s. If incorrect, feedback was a white noise sound played for 1 s. After an inter-trial interval of 1 s, the mouse could initiate another trial by again holding the wheel still for the prescribed duration.

**Data**:

figshare.com/articles/dataset/Dataset\_from\_Steinmetz\_et\_al\_2019/9598406

Mice bear names of scientists: most have 3 - 5 successive days of recordings

Depths of channels are measured from the tip of the electrode (inside-out).

Data Structures

S.spikes.times vector of spike times (in sec)

S.spikes.clusters identity numbers of neurons that fire (IDs start at 0)

S.channels.rawRow (indices: 1 to 374; values: 0 to 384) gives the corresponding raw row label in the LFP data (385 rows).

S.channels.brainLocation is a structure with four fields:

ccf\_ap; ccf\_dv; ccf\_lr: 748 doubles representing CCF coordinates in microns

allen\_ontology: [748×4 char]

clusters.templateWaveforms holds the wave forms of each neuron at each of the 50 channel locations listed in

clusters.templateWaveformChans, in order of variation size.

***Behavior variables provided in data***

They provide face motion, pupil diameter, wheel motion and licks; each are on different time scales. Most time scales are provided by a 2x2 matrix with frames (0-indexed) in first column, and beginning and end time stamps in the second column. However the time stamps for eye variables are in S.eye.timestamps(:,2) in Cori-12-14

The eye data

S.eye structure

There are many short glitches in eye data - usually in both position and area together. Often these occur during times of rapid motion, such as after a stimulus is shown.

The eye position variable name is 'xyPos', so I guess it's position of center of pupil, but I don't see documentation: both 'x' and 'y' seem to have Gaussian distributions with mean 0 and SD 1, so they must be standardized in some way.

The eye (pupil) position during testing seems to cluster in small areas. I don't see an obvious drift in response to stimulus onset. There are large artifacts: many of them seem to be 'y' taking over 'x' and 'x' being mirorred and displaced.

Licking

S.licks.times

Lick times (usually several hundred) at rates up to 8 times per second up to 10-15 times after trials

Wheel

S.wheel structure

Wheel positions recorded in (integer) ticks at a rate ~2500 / sec. I think the smallest meaningful fluctuations are on a scale of ~ 0.02 sec.