Recording from the same cortical neurons over months with Neuropixels probes

Anna Lebedeva[1], Nicholas Steinmetz[2], Marius Pachitariu[3], Jai Bhagat[1], Kenneth Harris[1], Matteo Carandini[1], Michael Okun[4]
[1]University College London, [2]University of Washington, [3]HHMI, Janelia Research Campus, [4]University of Leicester

Introduction

For many studies, it is important to track the activity of neurons over long periods. Neuropixels probes could be suited to this. Can they track neurons across recordings? If so, for how long?

Methods

We implanted mice with chronic Neuropixels 2.0 probes over visual cortex. Please refer to poster 2555 for more details on the new probe.

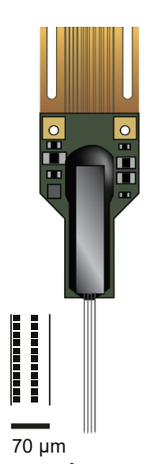
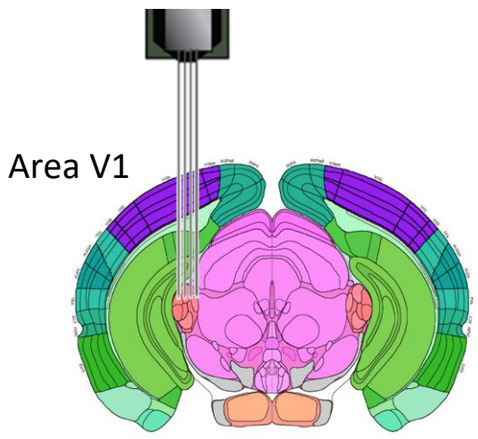


Fig.1



For recordings, mice were head-fixed in front of screens showing a library of natural images [1].

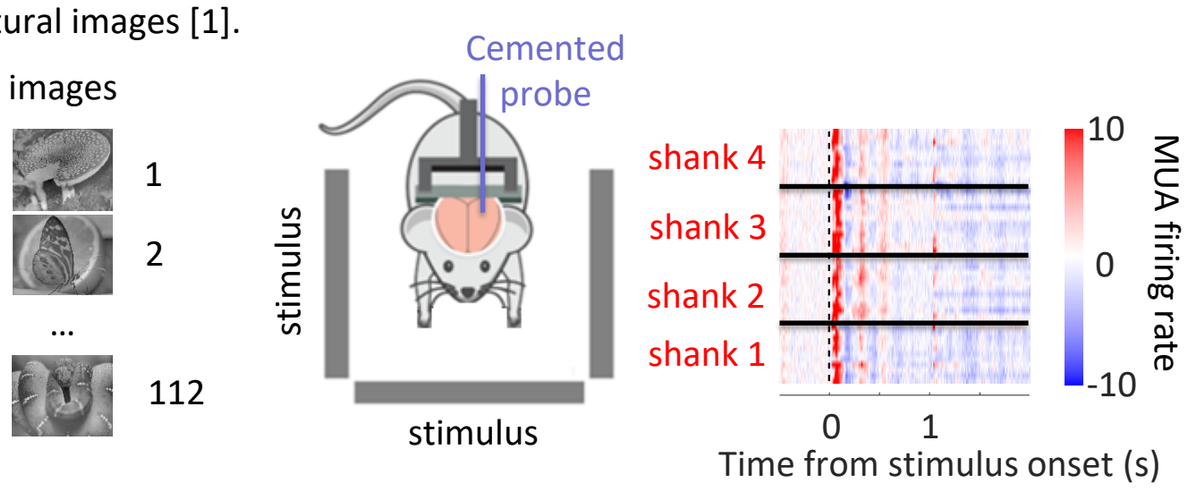


Fig.2

1. Recordings yielded neurons for over 6 months

Recordings yielded many neurons across >6 months, but there was substantial drift across sessions. To compensate for it, we used a modified version of Kilosort2 (no manual curation) [2]. Pairs of sessions were spike-sorted together.

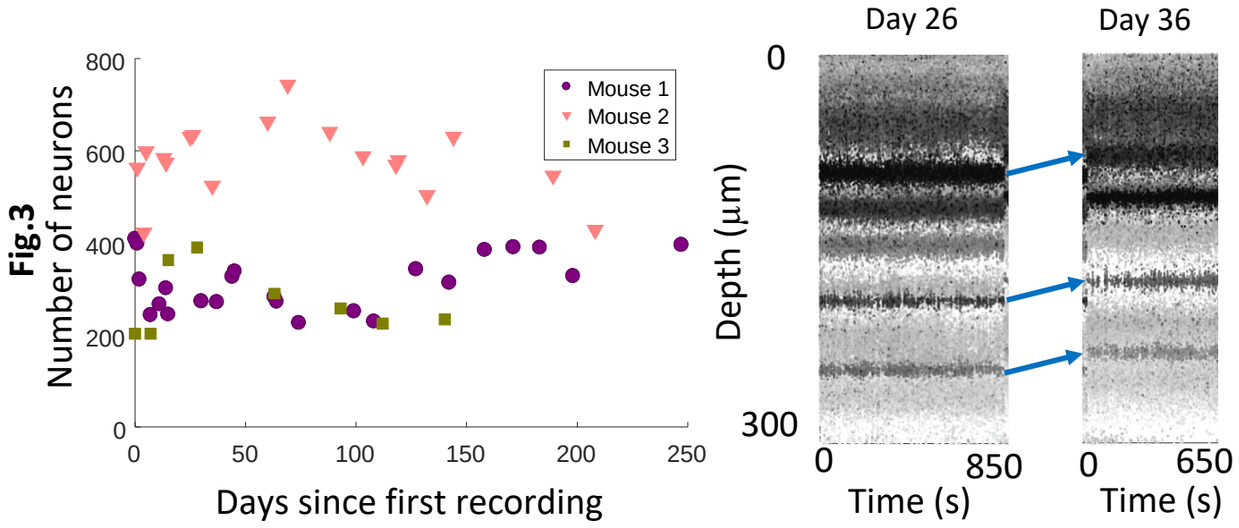


Fig.3

2. Many V1 neurons have unique visual responses

We define each neuron's signature by computing averaged responses to the library of visual stimuli.

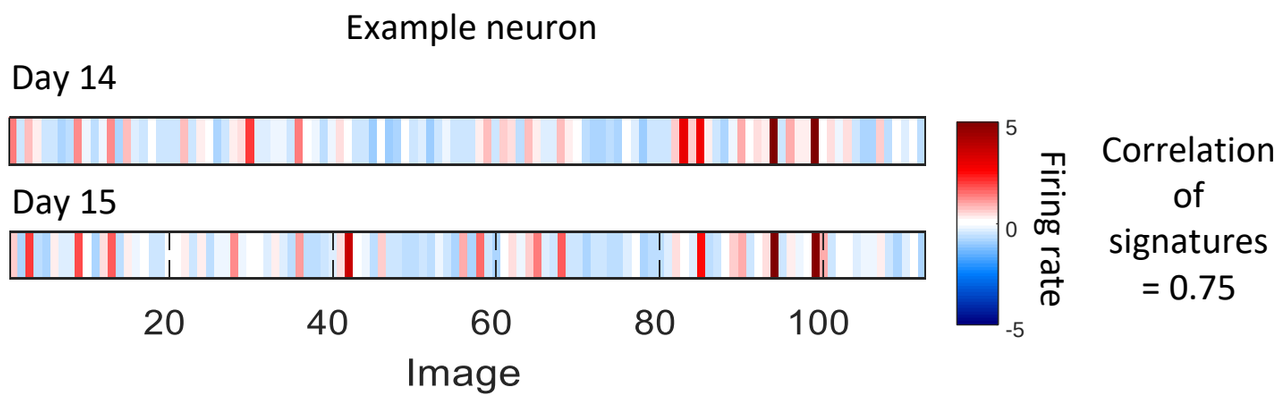


Fig.4

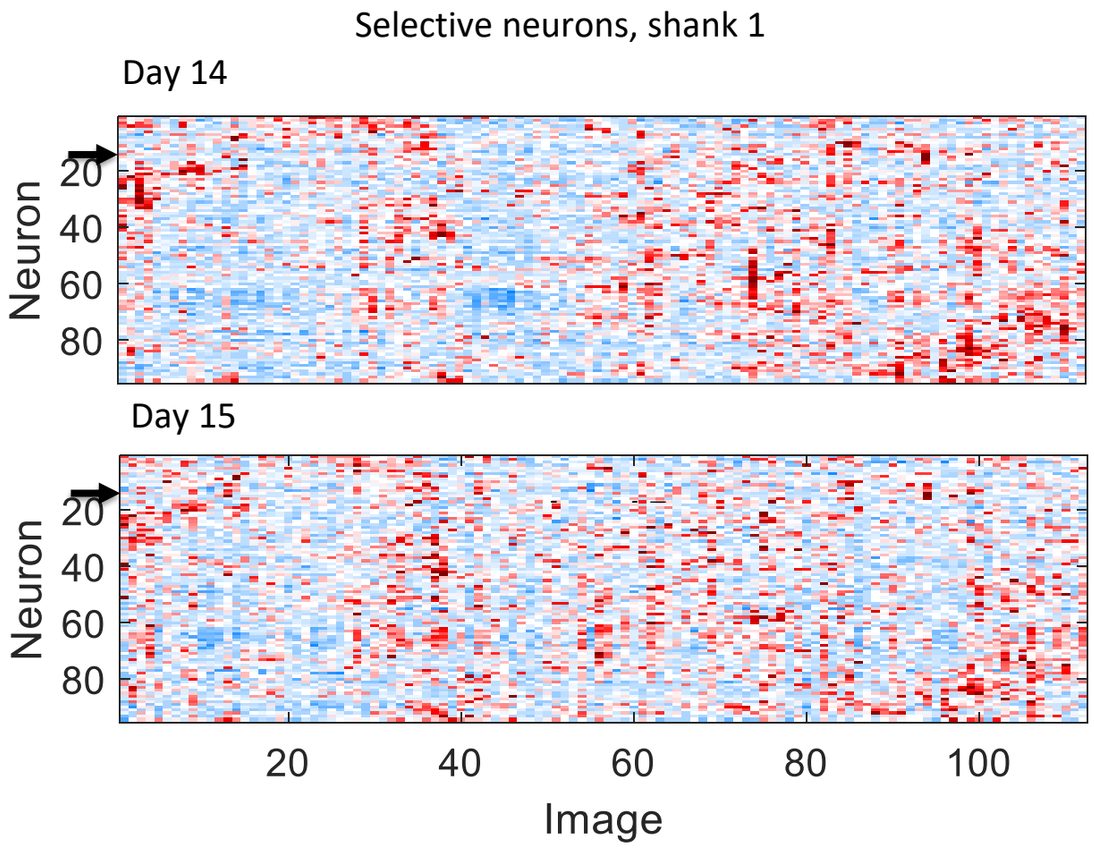


Fig.5

3. Unique visual signatures persist over days

For each signature on the first day, we find the signature from the second day that correlates with it the most. For most neurons, it is the same neuron's signature.

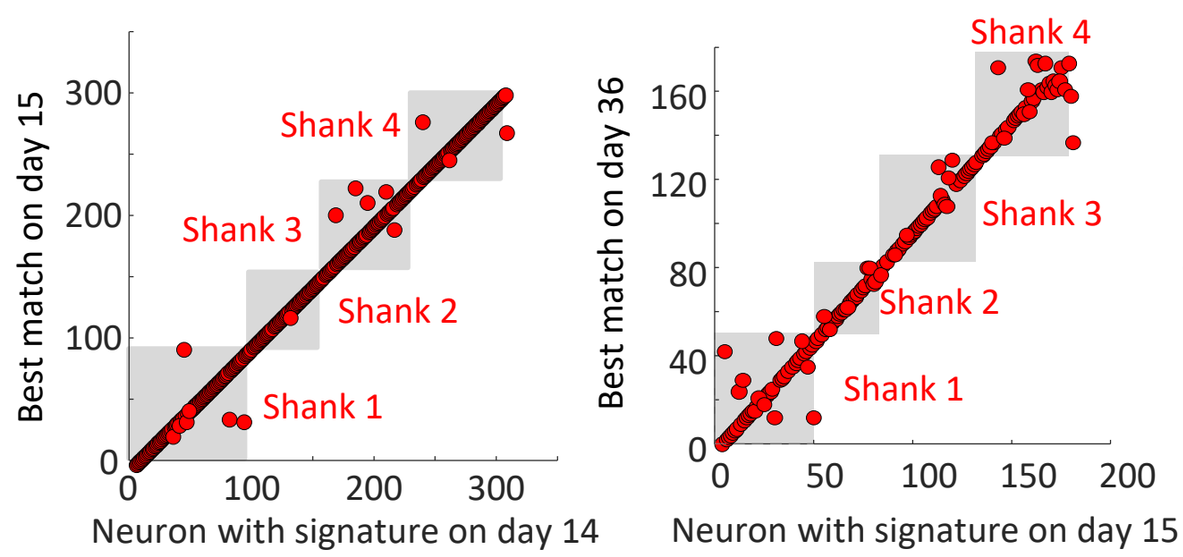


Fig.6

4. We can track the same neurons for months

We are able to track more neurons than previous state-of-the-art methods [4]. Each point represents a shank, in mouse 1 (●), 2 (▽), or 3 (■).

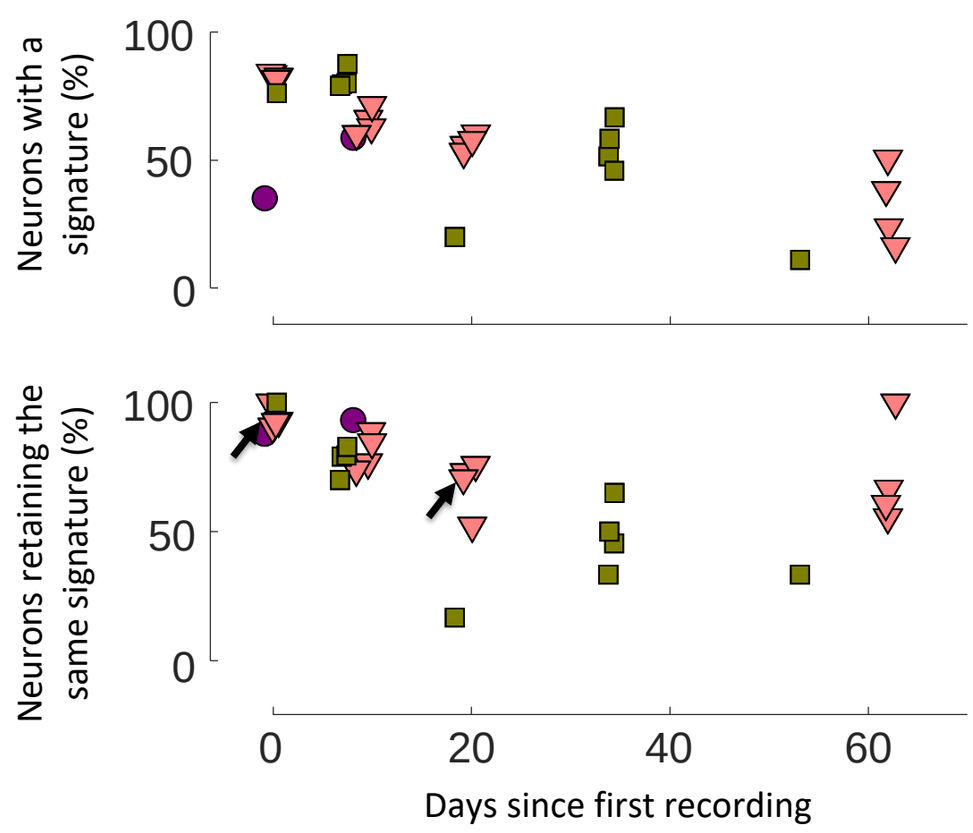


Fig.7

Conclusions

(1) With the Neuropixels 2.0 probes and the adapted Kilosort2 algorithm we can track the same cortical neurons over months.
(2) The dataset can be used to check reliability of tracking algorithms.
(3) The ability to follow large populations of individual neurons over months opens new possibilities in the study of learning and plasticity.

Virtual meeting room
https://meet.jit.si/ALebedeva2020
10:30 – noon BST on Sun, Mon

Email
Anna.Lebedeva.17@ucl.ac.uk

References
[1] Stringer et al, 2019
[2] Pachitariu et al, 2016
[3] Jun et al, 2017
[4] Dhawale et al., 2017