Durand et al., 2022 Nature Protocols

[We anticipate that the scale and richness of in vivo electrophysiology data will continue to improve dramatically in the coming years, as Neuropixels and other probes with novel architectures, denser recording sites and more shanks become available]

[By appropriately following the procedures described in this protocol, one can expect to record spiking activity for several hours from hundreds of individual cells.]

[... nearly 600 units were recorded across 13 different brain regions. The raw data from six Neuropixels probes was preprocessed ...]

[Analyses that examine the interactions between cells or between areas are especially useful, because of the high number of units that can be recorded simultaneously]

Thomas Zhihao Luo et al., eLife, 2020

Implant Neuropixel for multiple months

Reuse device

Record hundred of units

Paulk et al., 2022 Nature Neuroscience

Recorded from over 200 cortical single neurons in the human visual cortex?

Where before only a few neurons per electrode could be recorded.

[Neural recording systems for animal models have advanced more rapidly, which has included a recent landmark technological advance, the Neuropixels probe, a fully integrated linear silicon array covered with microelectrode contacts at 20-µm spacing (Fig. 1a). The Neuropixels 1.0 probes can simultaneously record from 384 user-selectable channels distributed along a 24 µm × 70 µm × 10 mm shank. This system, introduced in 2017, has already enjoyed widespread adoption for recording in rodents1,2 and non-human primates (NHPs)3, with continuing improvements4.]

Another downside is that we conventionally use microwires spread out that during electrode implantation spread out in an undetermined way. As a consequence spike detection and clustering cannot rely on local similarities between electrodes.

Typically a bundle of microwires can record neurons in the dozens, whereas electrodes available in rodents such as the Neuropixel allows recording hundreds of neurons (for a study in humans see Paulk et al., 2022 Nat Neuro).

Not in all cases can this difference in neuron yield be made up by recording more participants. In the context of this paper, recording hundreds of neurons in one patient would enable the analysis of between cell interactions, for example the detection of assemblies of Episode Specific Neurons. Something that is not feasable when recording few neurons.

Beyond this, between area interactions could be investigated (Durand et al., 2022 Nature Protocols). One concrete example would be a reinstatement of cortical representation driven by hippocampal ESNs. During encoding one would assume that the cortex is driving the hippocampal activity, while during retrieval the cortex lags behind the hippocampus (some study by maria wimber).

They report on three successful implantations, one in an epilepsy patient awating tissue resection and two DBS implatation procedures for movement disorders.

They made the probe ticker (Neuropixels 1.0-ST: thickness 100ym, width 70ym, length: 10mm).

The entire recording was done within the confines of the operating room and for 15 minutes.

rigid distances between neighboring spikes allows a higher quality spike sorting (not just higher quantity of neurons). The distance between contacts is 20 ym, which allows spike propagation across neighboring contacts.

ultra high density electrode