CRCNS.org spe-1 data description
Version 0.6 (Aug 21, 2018)

Simultaneous patch-clamp and dense CMOS probe extracellular recordings from the same cortical neuron in anaesthetized rats

André Marques-Smith, Joana P. Neto, Gonçalo Lopes, Joana Nogueira, Lorenza Calcaterra, João Frazão, Danbee Kim, Matthew G. Phillips, George Dimitriadis and Adam R. Kampff

Summary

In this dataset, we recorded simultaneously from the same cortical neuron using patch-clamp and extracellular (Neuropixel, 384 channel) probes, in urethane-anaesthetized rats (no stimulus, just spontaneous activity). A total of 43 neurons were recorded from in primary motor and somatosensory cortex. 38 neurons were recorded in cell-attached mode and 5 in whole-cell. Out of the 43 neurons that we patched, 21 showed clear extracellular spike waveforms, and for 10 of these the peak-peak amplitude exceeded 50 μV. For each neuron, we provide the raw extracellular recording file (action potential band, high-pass filtered at 300 Hz) and the corresponding patch-clamp recording, as well as sync channels for the two modalities, sample number for spike peaks in the patch-clamp recording, and corresponding sample numbers in the extracellular recording. Results from the experiments and detailed information about the dataset are described in:

Recording from the same neuron with high-density CMOS probes and patch-clamp: a ground-truth dataset and an experiment in collaboration.
André Marques-Smith, Joana Pereira Neto, Gonçalo Lopes, Joana Nogueira, Lorenza Calcaterra, João Frazão, Danbee Kim, Matthew G. Phillips, George Dimitriadis, Adam Kampff. *bioRxiv* 370080; doi: https://doi.org/10.1101/370080

We have also set up a companion repository featuring all the code used in the above publication, indications on how to load and interact with the dataset, and proposed follow-up projects for collaboration. Interested parties are welcome and encouraged to collaborate on these projects:

https://github.com/kampff-lab/sc.io/tree/master/Paired%20Recordings

Conditions for using the data

If you publish any work using the data, please cite the publication above (Marques-Smith et. al, 2018) also cite the data set using the following:

André Marques-Smith, Joana P. Neto, Gonçalo Lopes, Joana Nogueira, Lorenza Calcaterra, João Frazão, Danbee Kim, Matthew G. Phillips, George Dimitriadis and Adam R. Kampff (2018); Simultaneous patch-clamp and dense CMOS probe extracellular recordings from the same cortical neuron in anaesthetized rats. CRCNS.org
http://dx.doi.org/10.6080/K0J67F4T

Methods

Methods are fully described in Marques-Smith et al., 2018. The repository https://github.com/kampff-lab/sc.io/tree/master/Paired%20Recordings also includes useful information.

Data files organization

The dataset is organised in a directory structure by cell. Each directory is titled 'cxx' (cell xx), corresponds to a paired-recording and contains the following files:

- cxx_expt_meta.csv *Dimensions that Neuropixel and patch-clamp recording files should be reshaped to (channel, sample number) and their data type (int, float), when importing into Python or Matlab.*
- cxx_npx_raw.bin *Neuropixel recording (384 channels), 1D binary file. The shared data has only been offset-subtracted; no common average referencing or filtering has been performed on it, as different individuals have distinct preprocessing routines they prefer to use.*
- cxx_npx_sync.bin *Neuropixel sync channel, binary file.*
- cxx_patch_ch1.bin *Patch-clamp current or voltage, depending if cell was recorded in voltage- or current-clamp. No preprocessing has been performed on this shared data.*
- cxx_patch_sync.bin *Patch-clamp sync channel.*
- cxx_wc_spike_samples.npy *Patch-clamp recording samples corresponding to patched cell's spike peaks, numpy 1D array.*
- cxx_extracellular_spikes.npy *Only for the 21 cells where an extracellular spike waveform could be detected. Details Neuropixel recording samples*

corresponding to the peak of extracellular spikes in the channel closest to patched cell's soma, numpy 1D array.

- Data_Summary.xlsx *An excel table with metadata on each recording, including the cell and closest extracellular channel's spatial location, estimated distance between the two, number of spikes recorded in patch-clamp, average peak-peak amplitude of the extracellular spike in the closest channel, type of patch-clamp recording (cell attached voltage-clamp, current-clamp or whole-cell current-clamp)*

- Recording_Catalogue.pdf *A document with one page per cell showing some summary information figures for each recording, so the reader can find the recordings most likely to be useful to them.*

Data format

- cxx_expt_meta.csv – Comma-separated values. First column specifies number of channels (rows) and samples (columns) that the Neuropixel extracellular recording 2D array should be reshaped into. Second column specifies number of samples in the patch-clamp recording (only one channel).

- cxx_npx_raw.bin - Binary, in 16 bit signed integer. 1D vector, created from 2D array organised as 384 rows (channels) x n columns (samples). The data was written to file from this matrix in column-major (F) order, ie, the first sample in the recording was written to file for every channel, then the second sample was written for every channel, etc. This 1D binary should be imported and reshaped as per the dimensions specified in the expt_meta file. Values are in bits, not volts. Digitisation resolution was 2.34 μV per bit, so to obtain microvolt values, you should multiply by 2.34. See Marques-Smith et al., 2018 and https://github.com/kampff-lab/sc.io/tree/master/Paired%20Recordings for more detailed information. The repository contains code on how to load and correctly shape the array for neuropixel recordings. If you're using the recordings for spike-sorting, they should be ready to use directly. We have tested this in KiloSort and Phy.

- cxx_npx_sync.bin - This is a single synchronisation channel, with the same sample number length as npx_raw.bin.

- cxx_patch_ch1.bin - Data for the patch-clamp recording are already provided in pA or mV, depending if the recording was, respectively, performed in voltage- or current-clamp mode. Data is organised as a 1D array.

- cxx_patch_sync.bin - This is the synchronisation pulse as recorded by the patch clamp synchronisation channel.

- cxx_wc_spike_samples.npy - This is a 1D numpy array that contains the **patch-clamp sample numbers** corresponding to the peaks of spikes detected by threshold crossing in the patch-clamp recording.

- cxx_extracellular_spikes.npy - This is a 1D numpy array that contains the **extracellular sample numbers** for the channel closest to the patched cell, corresponding to the peaks of spikes detected in the patch-clamp recording.

- Data summary.xlxs - This is an excel spreadsheet with one row per cell. For each cell, a range of metadata is provided (specified by column headers). In the analysis code for the accompanying publication, this table is often used to retrieve information from through the Pandas python package.

- Recording Catalogue.pdf - This is a pdf document with summary information for each cell. Each cell has its own page. In that page, we show: a 100 ms random sample of patch-clamp activity and corresponding extracellular activity in the closest channel, that same segment in the 16 channels estimated to be closest to the patched cell, a random sample of 500 spikes detected in patch-clamp and corresponding extracellular traces for the closest channel, the average extracellular waveform of all spikes detected in patch-clamp for the 16 closest channels aligned to the patch-clamp spike peak, and finally, those same average traces plotted with respect to the probe channel layout.

How to get started

The repository (https://github.com/kampff-lab/sc.io/tree/master/Paired%20Recordings) has detailed instructions on how to load data in Python, as well as all the code used in Marques-Smith et al., 2018, which should help get you started. Marques-Smith et al. 2018 describes the dataset and features of it, so reading it is recommended.

How to get help

You can get help with the data set by posting any questions on the forum at CRCNS.org, raising an issue at the GitHub repository https://github.com/kampff-lab/sc.io/tree/master/Paired%20Recordings , or through direct email contact to andrefmsmith@gmail.com. We warmly encourage and welcome collaborations and

suggestions on follow-up analytical projects through the GitHub repository, as well as corrections on any bugs or mistakes we may have missed.

Change history

Version 0.6 (Aug 21, 2018). Original version.