

CRCNS.org ssc-3 data description

Version 0.8 (May 13, 2016)

Summary

These data contain a record of neuron spiking activity in mouse somatosensory cortex. The recordings were performed in organotypic slice cultures after 2 to 4 weeks *in vitro*. The recordings were performed with a large and dense multielectrode array (512 electrodes, 60 μm interelectrode spacing, 5 μm electrode diameter, flat electrodes, roughly 1 mm by 2 mm total array area). The cultures were not stimulated, so these data represent spontaneous activity. The spiking activity was spike sorted using PCA. Details about the recording method are described in [1, 2], and results from these particular data are presented in [1, 3-6]. All data are stored as Matlab files using standard Matlab structures.

In total, 25 recordings are provided, most of which possess hundreds of neurons (min: 98, max: 594, mean: 309, total: 7735). The average firing rate of the neurons was 2.1 Hz. The data were binned at 20 kHz and presented in units of milliseconds. The lengths of the recordings were approximately 1 hour.

Conditions for using the data

Before you publish any work using these data, we ask that you first consult the authors. Furthermore, please cite publications [1, 2] as these papers describe the experimental methods. Also, please consider citing to these additional works that used these data [3-6]. Finally, please cite the data set in the following recommended format:

Shinya Ito, Fang-Chin Yeh, Nicholas M. Timme, Pawel Hottowy, Alan M. Litke, and John M. Beggs (2016); Spontaneous spiking activity of hundreds of neurons in mouse somatosensory cortex slice cultures recorded using a dense 512 electrode array.
CRCNS.org
<http://dx.doi.org/10.6080/K07D2S2F>

Methods

The methods used to gather these data are described in [1-6]. In particular, the recording method and array are described in [2] and the first experimental results from these data are described in [1]. Additional papers that further describe the data and other analyses performed using these data are [3-6].

Data files organization

All data are contained in the Data directory. All information for each individual recording is contained in a numbered Matlab .mat file named DataSetX, where X is the number of the data set (1 to 25).

Data format

In each data set file, all necessary information for the individual recording is stored as a Matlab structure named data. Each field of the data structure is described below:

- data.spikes
 - A cell array that contains the spikes times for each neuron. Each cell in data.spikes is a vector that lists the spike times for the corresponding neuron in units of milliseconds sampled at 20 kHz (bin size of 0.05 ms). For example, in DataSet1, data.spikes{2}For(200) = 2051617.9. This indicates that the 200th spike of neuron 2 in DataSet1 occurred at 2051617.9 ms.
- data.nNeurons
 - An integer that represents the total number of spike sorted neurons in the recording. For all data sets, length(data.spikes) = nNeurons.
- data.timescale
 - A string that defines the time scale of the spike times listed in data.spikes. For all data sets, this is 1 millisecond.
- data.samplingfrequency
 - A string that defines the sampling frequency of the spike times listed in data.spikes. For all data sets, this is 20 kHz. This corresponds to a bin size of 0.05 ms.
- data.recordinglength
 - A real number that defines the length of the recording in milliseconds. For most data sets, this is 3600000 ms or 1 hour.
- data.x
 - A vector that lists the physical x coordinate in μm of the spike sorted neurons. The i^{th} element of data.x corresponds to the i^{th} neuron in data.spikes. Physical location was established via 2D Gaussian fit to the maximum value of the spike triggered average waveform across multiple electrodes. The array is rectangular with dimensions of approximately 2 mm by 1 mm. The long axis of the array is the x direction with the origin located at the center of the array.
- data.y
 - A vector that lists the physical y coordinate in μm of the spike sorted neurons. The i^{th} element of data.y corresponds to the i^{th} neuron in data.spikes. Physical location was established via 2D Gaussian fit to the maximum value of the spike triggered average waveform across multiple electrodes. The array is rectangular

with dimensions of approximately 2 mm by 1 mm. The short axis of the array is the y direction with the origin located at the center of the array.

- data.recordingID
 - A string that defines the date of the recording and the number of the recording for that day in YYYY-MM-DD-N format (Year, Month, Day, Number).

How to get started

Any individual data set can easily be loaded in Matlab using standard procedures. Once loaded, additional operations can be carried out by the user, primarily with data.spikes and the user's spiking data analysis software.

How to get help

To get help with the data set post any questions on the forum at CRCNS.org.

References

1. Ito, S., et al., *Large-scale, high-resolution multielectrode-array recording depicts functional network differences of cortical and hippocampal cultures*. PloS One, 2014. **9**(8): p. e105324.
2. Litke, A.M., et al., *What does the eye tell the brain?: development of a system for the large-scale recording of retinal output activity*. IEEE Transactions on Nuclear Science, 2004. **51**(4).
3. Timme, N., et al., *Multiplex networks of cortical and hippocampal neurons revealed at different timescales*. PLoS One, 2014. **9**(12): p. e115764.
4. Nigam, S., et al., *Rich-club organization in effective connectivity among cortical neurons*. Journal of Neuroscience, 2016. **36**(3): p. 670-684.
5. Shimono, M. and J.M. Beggs, *Functional clusters, hubs, and communities in the cortical microconnectome*. Cerebral Cortex, 2014: p. 1-15.
6. Timme, N.M., et al., *High-degree neurons feed cortical computations*. PLoS Comput Biol 12(5): e1004858. doi:10.1371/journal.pcbi.1004858