Manual

1 Structure of the Repository

This repository contains data from 4 multi-electrode array recordings of marmoset retinas that were stimulated with patterns of light. The data accompany the manuscript by Nitsche et al: "Diversity of Ganglion Cell Responses to Saccade-like Image Shifts in the Primate Retina". Each folder named according to the scheme *YYMMDD_XX* comprises one recording session including the following files:

- *general_info.txt*: Information about the marmoset's sex and age, the MEA, the mean light level, the pixel size used during the white noise stimulus, and the extent of the response phase used for analyzing saccade responses.
- *cell_classification.txt*: The manual classification of spike sorting clusters into cell types.

and a folder for each recorded stimulus containing:

- *spikes.npy*: The times of spikes of all clusters.
- *stimchanges.npy*: The times at which the stimulus changed.
- *stimulus.npz*: Detailed information about the stimulus presented. Only given for some stimuli (described below).

Only clusters from spike sorting which were considered to be good and possibly corresponding to cells were included in the data.

npy files can be used with, e.g., the python package numpy. Numpy's *load* function will return the data array stored in the npy file if the file path is given as an argument. For npz files, which are used to store multiple arrays, the *load* function will return a dictionary where individual arrays can be accessed with the syntax *dict_name*[*array_name*] with the names of the arrays specified below.

1.1 Cell Classification

All clusters were manually classified into the types On/Off parasol/midget and Large Off cells. Any remaining clusters were labelled as 'Miscellaneous'. The file *cell_classification.txt* contains those labels together with a number as an identifier for each cell, which is unique within that dataset.

1.2 Spikes

The file *spikes.npy* contains a numpy object array that stores the times at which spikes occurred grouped by cell. For each cell, there is one sub-array containing the times of all its spikes during the corresponding stimulus in seconds. The order of the cells is the same as in *cell_classification.txt*.

1.3 Stimulus Changes

In order to align recorded spike times and the timing of the stimulus, the file *stimchanges.npy* contains a numpy array with the times of all stimulus changes in seconds.

2 Stimulus Details and Reconstruction

Four stimuli were used to characterize and analyze the responses of retinal ganglion cells: The main saccadic stimulus (*saccadegrating*), a white noise stimulus to identify the receptive fields of cells and classify them (*FrozenNoise*), a stimulus containing grating flashes

(*reversinggratingswithvaryingspatialperiod*), and a full-field brightness steps stimulus on which the models are based (*onoffsteps*). For each stimulus, there is one folder per recording session named *xx – stimulus*, where *xx* is a running number counting the stimulus recorded, and *stimulus* is the stimulus identifier mentioned above.

2.1 saccadegrating

For the saccadic stimulus, *stimchanges.npy* contains the times of all fixation and transition onsets. The order of fixation positions is stored in *stimulus.npz* in an array named *fixations* (numbers of 1 to 4). The transition types are stored as the array *transitions*, where 0 stands for a gray transition and 1 for a motion transition. The stimulus starts with a fixation.

For our analysis, we truncated the first 4 fixations and transitions to allow for adaptation, but the data include the entire recording. The file *general_info.txt* contains information about where we determined the border of the first and second response phase to be for our analysis, which is dataset-specific due to differing response latencies.

2.2 FrozenNoise

The white noise stimulus consisted of an alternating sequence of 1500 frames of running noise and 300 frames of frozen noise (starting with the former). *stimchanges.npy* contains the onsets of all frames. The file *stimulus.npz* contains a 4D numpy array named *running_noise* storing the presented running noise stimulus. The first dimension iterates over the stimulus cycle, the second is time, the third x-direction, and the fourth y-direction. Only completed stimulus cycles are included. The array is Boolean, where *True* stands for a white pixel and *False* for a black pixel. The size of the noise pixels is given in *general_info.txt*. *stimulus.npz* also contains a numpy array called *frozen_noise* which contains the frozen noise stimulus presented in between running noise segments. It is 3D with the dimensions time, x-direction and y-direction.

2.3 reversinggratingswithvaryingspatialperiod

For this stimulus, *stimchanges.npy* contains the onset, offset and reversal times of the gratings. The stimulus begins with one second of gray which is also marked in *stimchanges.npy*. The stimulus can be completely reconstructed using the description in the manuscript methods section, since it does not involve random numbers.

2.4 onoffsteps

The brightness steps stimulus starts with full-field gray, then goes to white, gray, black, gray again and so on. *stimchanges.npy* contains the times of all brightness changes including the first onset of gray.

For our analysis, we truncated the first cycle to allow for adaptation, but the data include the entire recording.

3 Sample Cells Used in Figures

To generate the figures in the manuscript, we showed the responses of several sample cells. These are:

- Figure 1B, C: cluster id 19573 from dataset 180724_SZ, 4232 180712_YE, 5115 180712_YE.
- Figure 2: 4232 180712_YE
- Figure 3C (sample RFs): 7968, 16434, 2438, 6080, 39023 from 180808_DK
- Figure 4A: 3885 180712_YE, 21 180710_YE (both On parasols), 1316 180710_YE, 47153 180724_SZ (On midgets), 2846 180724_SZ, 1444 180710_YE (Off parasols), 2677 180710_YE, 7844 180710_YE (Off midgets), 5325 180710_YE, 4255 180710_YE (Large Off cells)
- Figure 6A, B: 14238 180724_SZ, 32 180710_YE, 41154 180724_SZ, 29061 180808_DK, 5115 180712_YE

- Figure 7A: 61 180710_YE, 1309 180710_YE, 2324 180710_YE, 7766 180710_YE, 12049 180710_YE
- Figure 7B: 61 180710_YE
- Figure 8A-D: 185 180710_YE, 32 180710_YE
- Figure 9A-D: 1011 180710_YE, 5450 180710_YE, 999 180710_YE