Data archive accompanying the paper by Bemme et al. (2017) in IOVS

Manual

This archive contains the data that were analyzed in the paper „Differential Effects of HCN Channel Block on On and Off Pathways in the Retina as a Potential Cause for Medication-Induced Phosphene Perception“, Invest Ophthalmol Vis Sci 2017, 58:4754-4767, by Bemme, Weick, and Gollisch.

Link to the paper: https://iovs.arvojournals.org/article.aspx?articleid=2654575.

The data are spike times of retinal ganglion cells, recorded extracellulary from isolated mouse retina with multi-electrode arrays, under visual stimulation projected onto the photoreceptor layer. In some of the experiments, the HCN-channel blocker ivabradine (3 µM) was bath-applied to the retina for part of the experiment.

Structure of the archive

The folder SpikeTrainData in the archive contains the data as compressed archives (.7z-format). Each .7z-file contains the data of a single recording session, comprising all the data from a single piece of retina. The name of the .7z-file specifies the date (format yyyymmdd) and the specific piece of retina of that day (e.g., FirstRetinaSecondPiece would be the second piece from the first retina of the day).

Unpacking yields a folder of the same base name as the .7z-file, which contains:

- a folder “spiketimes” with all the spike times of the analyzed ganglion cells to different visual stimuli,
- a folder “frametimings” with time stamps that mark stimulus events for alignment of spike times with applied visual stimuli,
- a Microsoft word file “protocol….docx”, which contains notes about this recording session, in particular, which visual stimuli were shown and if ivabradine was applied.

Names and format of data files

A specific spike train file in “spiketimes” can be identified by its name, which has the format “xx_SP_Cyyyzz.txt”. Here, xx is the 1- or 2-digit stimulus number, corresponding to the number in the first column of the table in the protocol file. This can be used, for example, to identify spike-train files for a specific stimulus, say the first run of steps of light intensity (“onoffsteps”), see below. yyyzz is an ID for the specific cell, so this can be used to identify data from specific cells across different stimuli. yyy is a 1- to 3-digit identifier of the electrode number to which this cell was assigned, and zz is the 2-digit identifier of the cluster number (from the clustering of spike wave forms associated with this electrode) to which the spikes from this cell were assigned. All spike-train files contained in this archive were identified as single-cell units of sufficient quality to be included in the analysis of the original paper.

For aligning the spike times with the stimulus, the corresponding file in “frametimings” is needed, which can be identified by the number at the beginning of the file name. This again corresponds to

the stimulus number and thus should be the same as the first number of the spike-times file. The rest of the file name in the "frametimings" folder roughly identifies the type of stimulus that was applied, see below.

Both the spike-times files and the frame-timings files are text files (.txt) and contain times in seconds in ASCII format. The times denote the occurrence of spikes and the occurrence of specific stimulus frames ("frame times" or "pulses") in seconds after start of the recording. Which specific stimulus frames are marked is explained below when the individual stimuli are described.

Types of stimuli

There are three types of stimuli used in the experiments, which are described in the following.

Steps of light intensity ("onoffsteps50"): Here, light intensity was periodically switched between high light intensity ("white", +100% Weber contrast) and low light intensity ("black", -100% Weber contrast). The switching occurred every about 830 ms, and the start of the stimulus as well as every switch is marked by a frame-timing event in the corresponding "frametimings"-file.

Constant illumination to measure spontaneous activity ("spontaneousactivity"): Here, spikes were recorded while the retina was illuminated with constant light intensity, as specified in the protocol file (either mean light intensity of the other applied stimuli, "grey", or with the illumination turned off, "black"). As there were no specific stimulus events, the corresponding "frametimings"-file contains no relevant entries and can be ignored for analyzing spontaneous activity.

Flickering full-field light intensity ("fff_Gauss2blinks"): Here, the light intensity (illumination of the entire retina) flickered according to a pseudo-random process. The intensity values were drawn independently at 30 Hz from a Gaussian distribution, centered around the given mean light intensity and with a contrast of 30% (defined as the standard deviation of the Gaussian relative to the mean). The file "stimulus_fff_Gaussian_seed_m1000.txt" contains the list of applied contrast values in ASCII, but normalized to a standard deviation of unity. Note that the length of the number sequence in the file is on the safe side, that is, a longer list of numbers is provided than actually needed. The corresponding frame times denote the times when a new contrast value was presented (at 30 Hz). The first pulse time denotes the beginning of stimulus, starting with the first contrast value in the list.

Types of experimental protocols

Two principle types of experiments were performed as part of this study. The first focused on basic characterizations and is therefore called the "basic" experiment type in the protocol file. The second focused (not exclusively) on measuring temporal filtering under full-field flicker of light intensity and is therefore called the "fullfieldflicker" experiment type in the protocol file. Each type of experiment was performed on different retina pieces either with or without the application of ivabradine. When ivabradine was applied, it was washed in after the first few stimuli and washed out later. In the protocol files, there is a note about the wash-in and wash-out of ivabradine next to the first stimulus that was applied after wash-in or wash-out, respectively. In control experiments (without ivabradine), the perfusion was switched between two identical solution reservoirs at the equivalent times during the experiment. The "basic" experiment was performed both under photopic and mesopic illumination conditions; the "fullfieldflicker" experiment only under mesopic conditions.

Whether an experiment applied ivabradine or was used as control and which illumination condition was applied is noted in the protocols file.

In the “basic” experiment, the typical sequence of applied stimuli was:

1. Steps of light intensity (2 min)
2. Measurement of spontaneous activity (2 min)
3. Flickering full-field light intensity (5 min)
4. Measurement of spontaneous activity (10 min)
   *** Wash-in of ivabradine or control solution ***
5. Measurement of spontaneous activity (20 min)
6. Steps of light intensity (2 min)
7. Measurement of spontaneous activity (2 min)
8. Flickering full-field light intensity (5 min)
9. Measurement of spontaneous activity (10 min)
   *** Wash-out of ivabradine or control solution ***
10. Measurement of spontaneous activity (20 min)
11. Steps of light intensity (2 min)
12. Measurement of spontaneous activity (2 min)
13. Flickering full-field light intensity (5 min)
14. Measurement of spontaneous activity (10 min)

Some recording sessions deviated slightly from this protocol, and the actual list can be checked in the protocol file.

In the “fullfieldflicker” experiment, the typical sequence of applied stimuli was:

1. Steps of light intensity (2 min)
2. Measurement of spontaneous activity (2 min)
3. Flickering full-field light intensity (6 min)
   *** Wash-in of ivabradine or control solution ***
4. Measurement of spontaneous activity (2 min)
5. Flickering full-field light intensity (6 min)
6. Measurement of spontaneous activity (2 min)
7. Flickering full-field light intensity (6 min)
8. Measurement of spontaneous activity (2 min)
9. Flickering full-field light intensity (6 min)
   *** Wash-out of ivabradine or control solution ***
10. Measurement of spontaneous activity (2 min)
11. Flickering full-field light intensity (6 min)
12. Measurement of spontaneous activity (2 min)
13. Flickering full-field light intensity (6 min)
14. Measurement of spontaneous activity (2 min)
15. Flickering full-field light intensity (6 min)
16. Measurement of spontaneous activity (2 min)

Again, some recording sessions deviated slightly from this protocol, and the actual list can be checked in the protocol file.

List of recordings

For easier identification of which recording corresponds to which protocol (without having to refer to the individual protocol files), here is a listing of the recordings in each of the groups (basic vs. fullfieldflicker, photopic vs. mesopic, and ivabradin vs. control):

<u>basic, photopic, ivabradin:</u>
- 20120511_FirstRetinaSecondPiece
- 20120516_FirstRetinaFirstPiece
- 20120523_FirstRetinaFirstPiece
- 20120523_FirstRetinaSecondPiece

<u>basic, photopic, control:</u>
- 20120523_FirstRetinaThirdPiece
- 20120601_FirstRetinaSecondPiece
- 20120606_FirstRetinaFirstPiece
- 20120606_FirstRetinaSecondPiece
- 20120606_FirstRetinaThirdPiece

<u>basic, mesopic, ivabradin:</u>
- 20120628_FirstRetinaFirstPiece
- 20120628_FirstRetinaThirdPiece
- 20120705_FirstRetinaFirstPiece
- 20120705_FirstRetinaSecondPiece
- 20120713_SecondRetinaSecondFirstPiece

<u>basic, mesopic, control:</u>
- 20120713_FirstRetinaFirstPiece
- 20120713_FirstRetinaSecondPiece
- 20120713_FirstRetinaThirdPiece

<u>fullfieldflicker, mesopic, ivabradin:</u>
- 20120725_FirstRetinaThirdPiece
- 20120725_SecondRetinaSecondPiece
- 20120725_SecondRetinaThirdPiece
- 20120808_FirstRetinaFirstPiece
- 20120808_FirstRetinaSecondPiece
- 20120808_FirstRetinaThirdPiece
- 20120823_FirstRetinaFirstPiece

<u>fullfieldflicker, mesopic, control:</u>
- 20120718_FirstRetinaFirstPiece
- 20120725_FirstRetinaFirstPiece
- 20120725_FirstRetinaSecondPiece
- 20120815_FirstRetinaThirdPiece
- 20120823_FirstRetinaSecondPiece
- 20120920_FirstRetinaThirdPiece
- 20120928_FirstRetinaFirstPiece
- 20120928_FirstRetinaSecondPiece