**Behaviour toolbox**

This toolbox was created to streamline ROI selection for Video acquisition in the SilverLab. The general use case is the following one:

* You recorded mouse behaviour using one or multiple camera.
* You need to check all your many many videos, and select some ROI (for motion index, pupile tracking
* The location of these ROI is not exactly the same across days, so you need to do visual inspection

This toolbox will help go through all the video as fast as possible, easily manipulate/Select ROIs. The Results are stored in a database-like structure (see below). ROI location and other video info can be manipulated to do batch analysis. The only preparatory work required is to regroup the videos folders by day and experiments.

# Setup and general information

## Setup

The current toolbox is in the private repository:

<https://github.com/SilverLabUCL/behaviour_toolbox>

Please use the master branch, Contact Antoine if you don’t have access

Video Folder Pre-processing

The database uses the lab filename system to organise the results. Before starting, you must put all your video of interest together, in a same “top folder”, and if possible, move all the video belonging to other experiments elsewhere, in another folder. The system uses the fact that videos taken during a same experiment point at the same location. Therefore, they must be regrouped by experiments.

The videos must be organized as follow:

* Top\_folder (contains all the videos that will be monitored. Take irrelevant videos away)
  + Day of experiment in the following format ”yyyy-mm-d”
    - Experiment folder in the following format “experiment\_#”
      * Your Videos (Labview format is “yyMMdd\_hh\_mm\_ss VidRec”

Each LabVIEW video folder is expected to contain the following elements:

* Your Videos (Labview format is “yyMMdd\_hh\_mm\_ss VidRec”

Timestamp\_file per camera

* + “yyMMdd\_hh\_mm\_ss VidRec” subfolder

XXXCam-1.avi

XXXCam-relative times.txt

YYYCam-1.avi

YYYCam-relative times.txt

Note: an “experiment” is defined by a series of consecutive video recordings where ROIs will be identical. Some computation will be shared between videos of the same experiment, using the same ROI location across the recordings, which means the camera must not have moved. If you had to move some cameras during an experiment, it is recommended to split the experiment in 2.

## General data structure

The data is organised following a hierarchical structure. Each level is defined by a class, with its own methods and dynamic properties

Analysis\_set

Experiment

Recording

Video

ROI

Each parent structure can list its children properties. See class documentation, or use cases at the end of the documentation for more details.

# First run and database initialization

## Initialise the toolbox

Start the GUI by typing

something = Behaviour\_analysis();

This will open the GUI.



## Start a new analysis:

Select the folder containing all your video (“Top\_folder”), as described before. All valid videos in this folder will be listed. This may take some time, in particular if the videos are on a remote server. After this step, a local copy of the folder path is stored, which speed up data manipulation. If you change the content of the video folder, you will need to refresh this list. See “Updating Source”.

Please keep an eye at the messages printed during this initial listing, as they could indicate problematic videos. The toolbox does not support split videos (yet).

Once finished, you should see an updated GUI.

Note : As this step can be very long, it is recommended to save your database once the list was generated. See “backup analysis”

# Backup Analysis

## Manual backup

As some steps can be extremely time consuming, it is recommended to do some regular backup of your analysis database. To do so, click on “Save Analysis” . An automated filename with a timestamp is proposed.

## Manual Reload

If you resume a previous analysis, or if something went wrong and you want to return to a previous stage, you can use the “Load Existing Analysis” button, and reload one of the ‘.mat’ file used for backup.

## Recover from interrupted analysis

When extracting motion indices, you may interrupt your MI extraction. An error could also emerge from a server connection issue, or a corrupted issue. If this happens, you can restore to the last valid state by clicking on . After doing this, you should immediately backup the database.

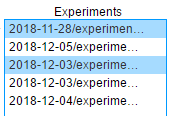
## Auto saving

Not available yet, but could be easily implemented.

# Browse Data and Database

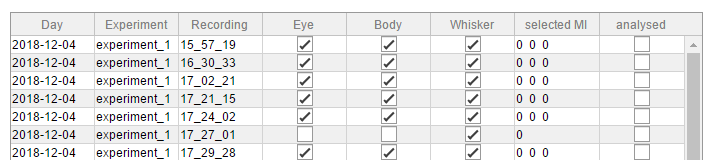
## Data selection

The experiment section lists the experiment available in the “top folder”. You can select or multiple experiments at once.



Any data extraction will be done on the current selection.

The recordings listed in the selected experiments are displayed on the left



* ‘Eye’, ‘Body’ and, ’Whisker’ columns indicated the availability of the videos. In the example above, the recording 17-27-01 only has a WhiskerCam recording, while other recordings have all video recordings.
* The selected MI column indicates how many ROIs were selected for each video
* The analysed column indicates if the motion indices were all analysed or not.

## Open Video/Open folder

You can select a specific video, or open its containing folder by clicking on ‘Open Video’ or ‘Open Folder’





## Updating Database

If you added or deleted folders, you can click on “Refresh File List” . Existing analysis will be kept.

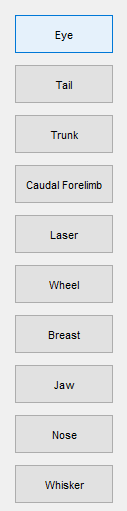
Note : This process will take as long as the initial listing, which can last seconds to minutes depending on the location and number of the files

# Select ROIs

Now that the files were listed, you can select the location of the ROIs. The process is done for all the selected experiments. ROIs are the same for all videos of a given experiment (unless there is missing video). For example, if you select an experiment that has recordings with the EyeCam and the BodyCam, you will have to select the location of you ROIs for each one of these videos, but only once for the full experiment

To select ROIs : Click on ‘Select/Browse ROIs’. . ROIs you already selected will be displayed. New ROIs can be added, and old ROIs can be removed.

## Quick Selection



Preset names are displayed on the left. The list originates from behaviour\_GUI.Experiment\_set.default\_tags. You can edit this list to add/remove quick tags.

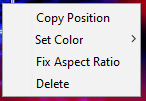
## Manual Addition

You can also do a right click on the image to add an ROI. Roi will be named in order of selection

## Editing ROIs

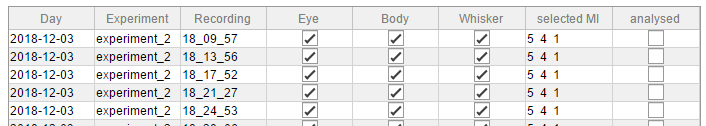
ROIs being added have they name in red. A right click on the ROI allow you to delete it.



Type the “return” key to validate and move to the next camera / next experiment. Once done on your selection, if you click on “select/Browse ROIs” again, the previously selected ROIs will be displayed in yellow



Once selected, the number of ROIs in the selection is displayed in the table.



# Analysis

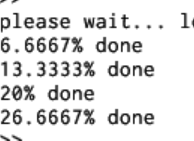
Once defined, you can calculate motion index for each ROI. Select the experiment/Group of experiment to process in the “experiments” column, then click on . This will start the analysis process.

Videos that had all their Motion indices calculated are skipped, but if any MI was added, we recalculate all Mis.

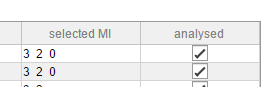
You can force the recalculation at any time by ticking:



For each video, the analysis progress is displayed in the command



Once all MIs are calculated, the analysed checkbox is ticked.

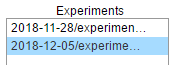


# Updating Motion Indexes

## Update a set of MIs

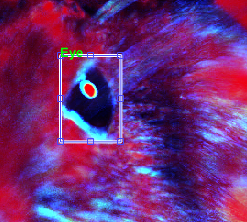
If you already analysed an experiment/Group of experiments but want to check the position of the existing ROIs, proceed as follow:

* Highlight the experiment to check. You can select or or multiple experiments

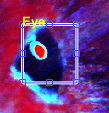


The individual recordings are displayed on the experiment window

* Browse the experiments
* ROIs that were analysed are displayed in green. These ROI were already extracted.



If you move/resize a green ROI, the label will turn yellow, indicating that a new MI extraction will be necessary.

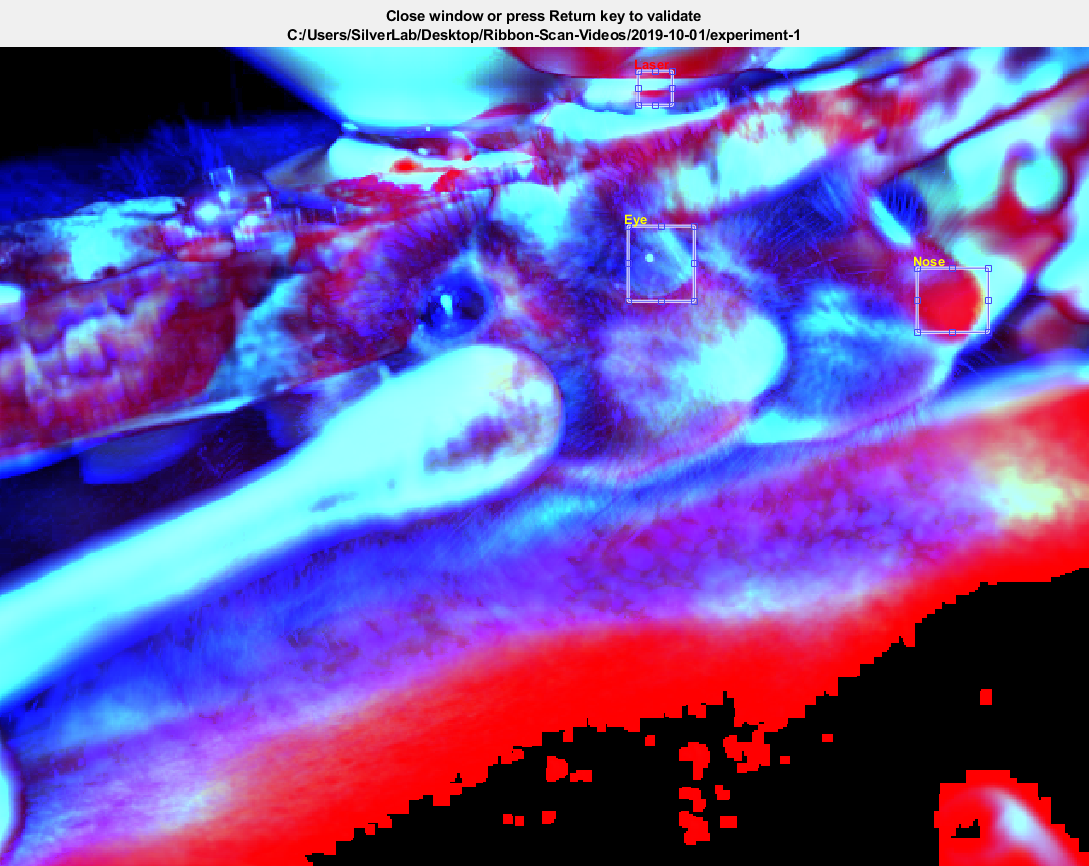


After validating the change (i.e. after closing the window), the analysed checkbox will be unchecked, indicating that reanalysis is required.

Note : If you move the Motion index on the consensus frame, the ROI is moved accordingly for all videos in that experiment

## Correct for camera movement

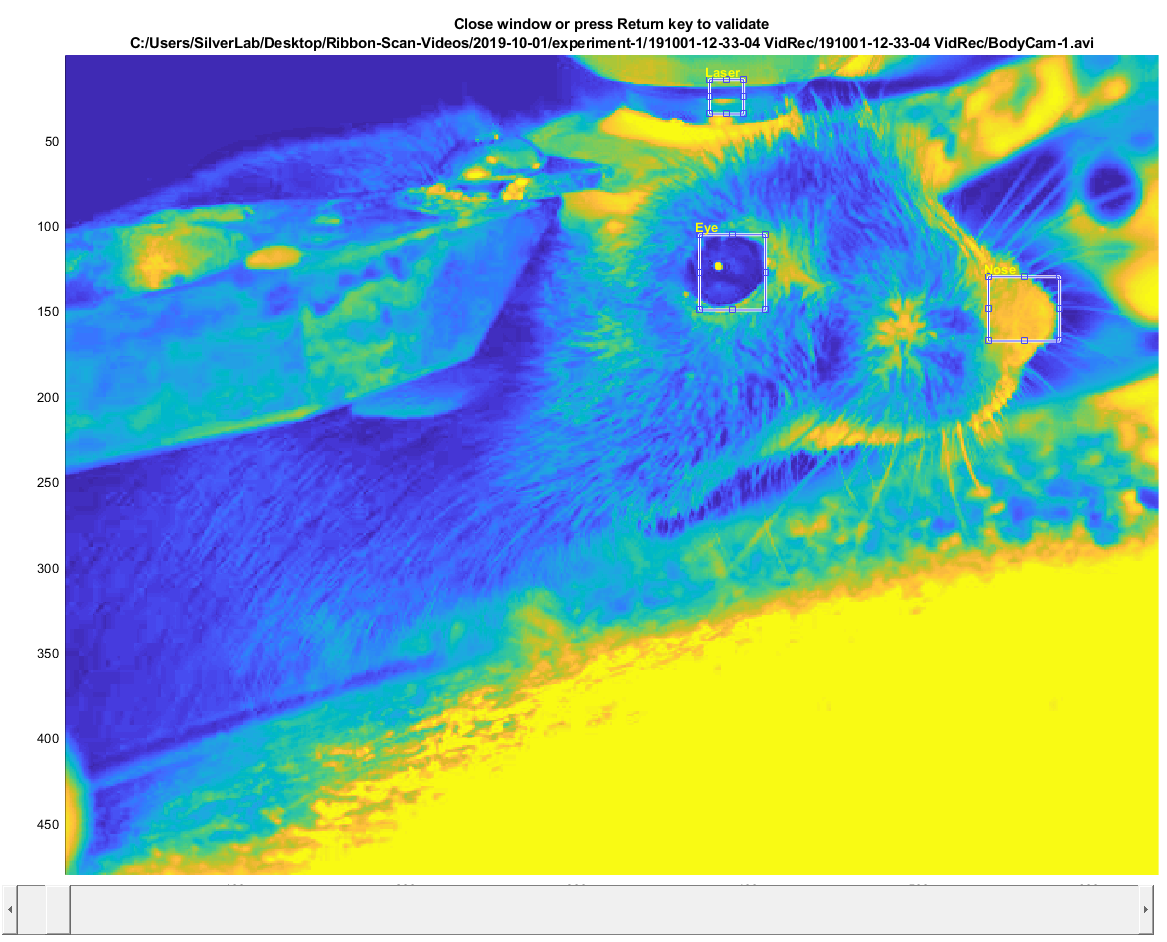
During an experiment, you may have camera movement. You have the possibility to introduce and offset for all ROIs. ROIs will all have the same offset for a given video. ROI size cannot be changed during recordings

To correct for camera displacement, you must first specify ROI location in the consensus frame. When the camera moves, the consensus frame may be blurry or show multiple ghost images, due to a camera offset. The ROIs should be correct for the beginning of the experiment. 

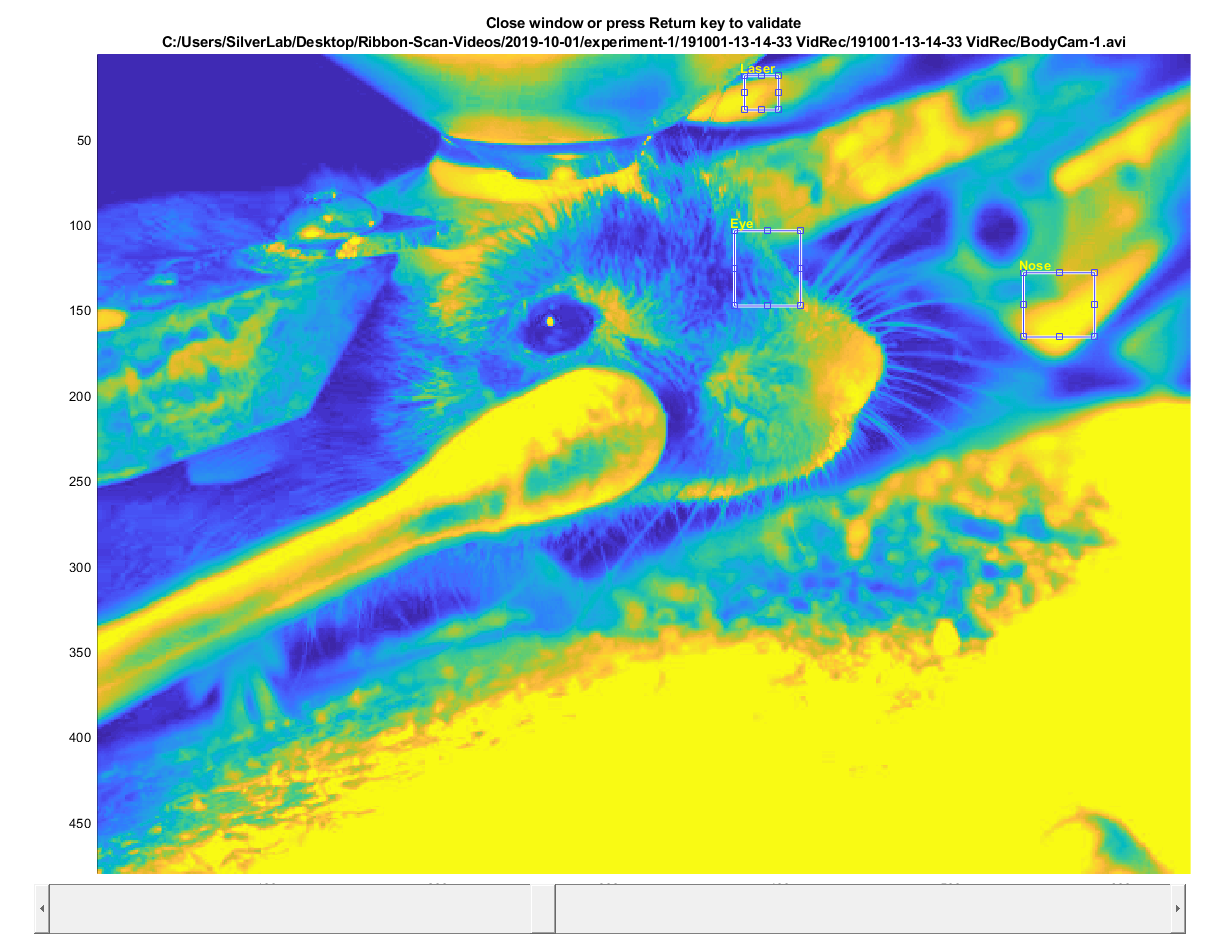
You can use the slider at the bottom of the figure to move across the recordings. The first position of the slider corresponds to the consensus frame, while the following ones correspond to each video of the recording.



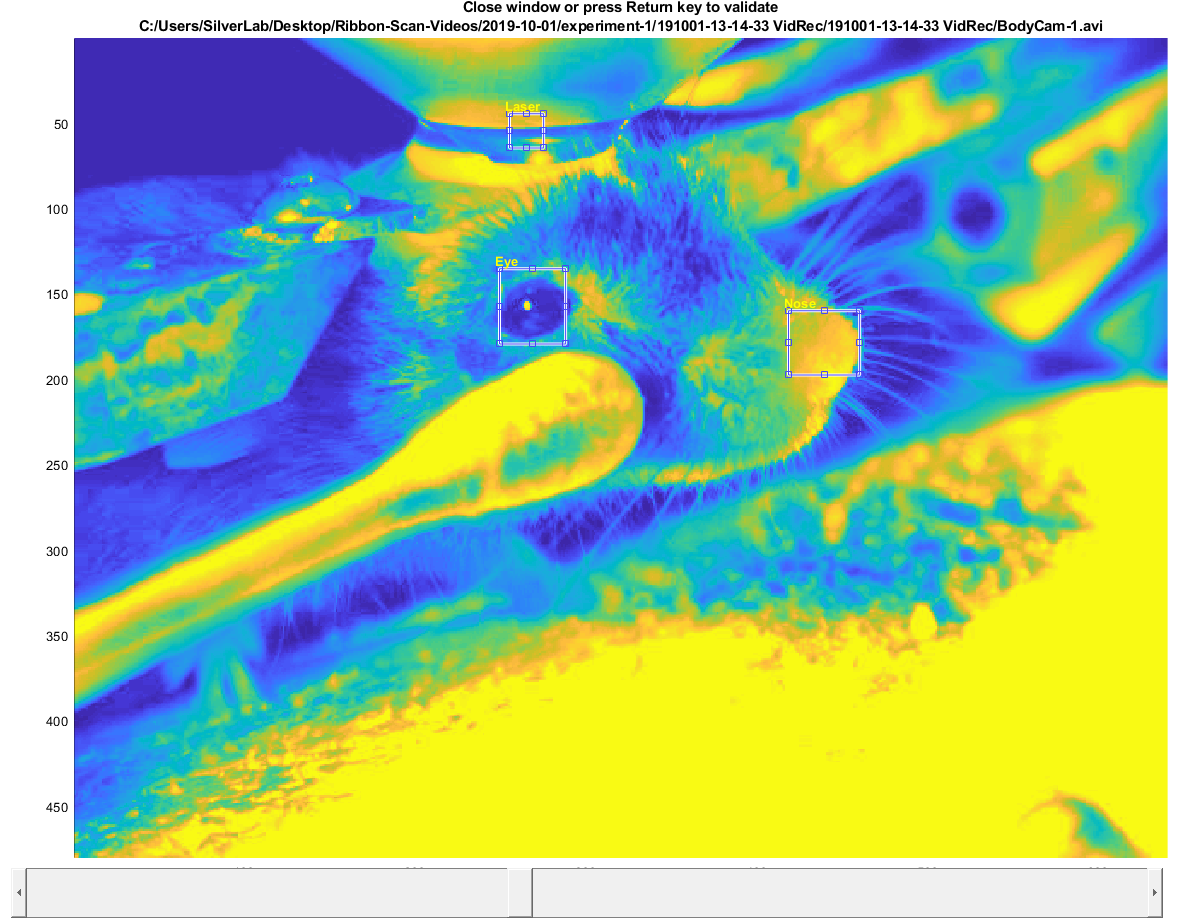
For example, the ROIs were selected correctly for the first recording :



However, a later video displays an offset:



You can drag the ROIs (which will move together) to the correct location.

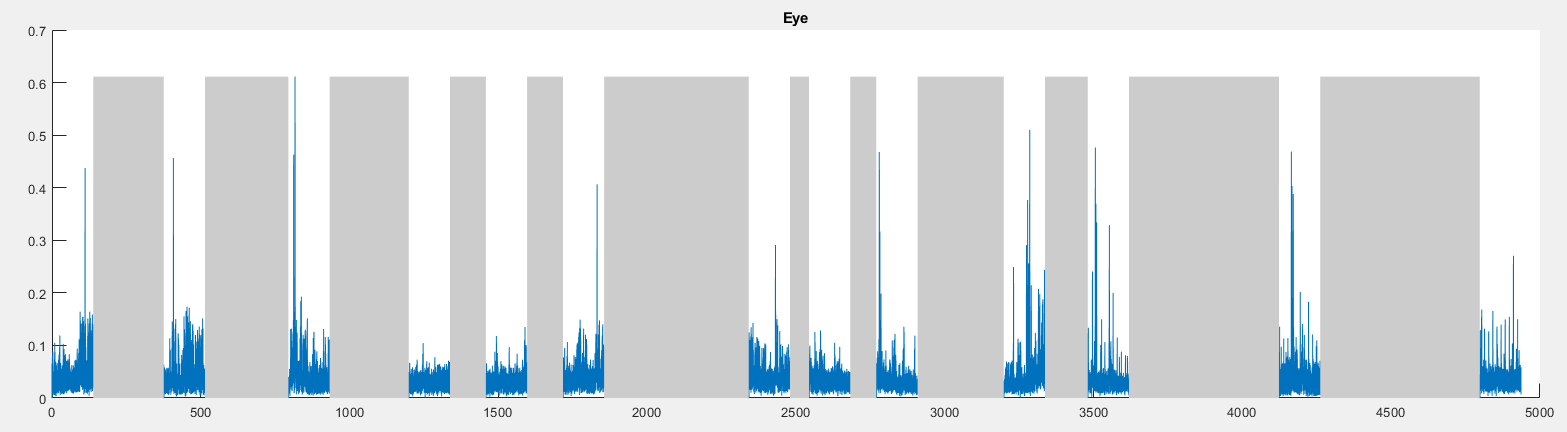


Note: The offset is automatically applied to all the following recordings, although you can set a second different offset on a later video (which will, in turn, be applied to all the subsequent video. See example below. In red, we indicate the only video that needed a manual intervention

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **video** | Consensus\_frame | rec\_1 | rec\_2 | rec\_3 | rec\_4 | rec\_5 | rec\_6 | … | rec\_end |
| **offset** | [0 , 0] | [0,0] | [0,0] | [10,20] | [10,20] | [10,20] | [40,15] | [40,15] | [40,15] |

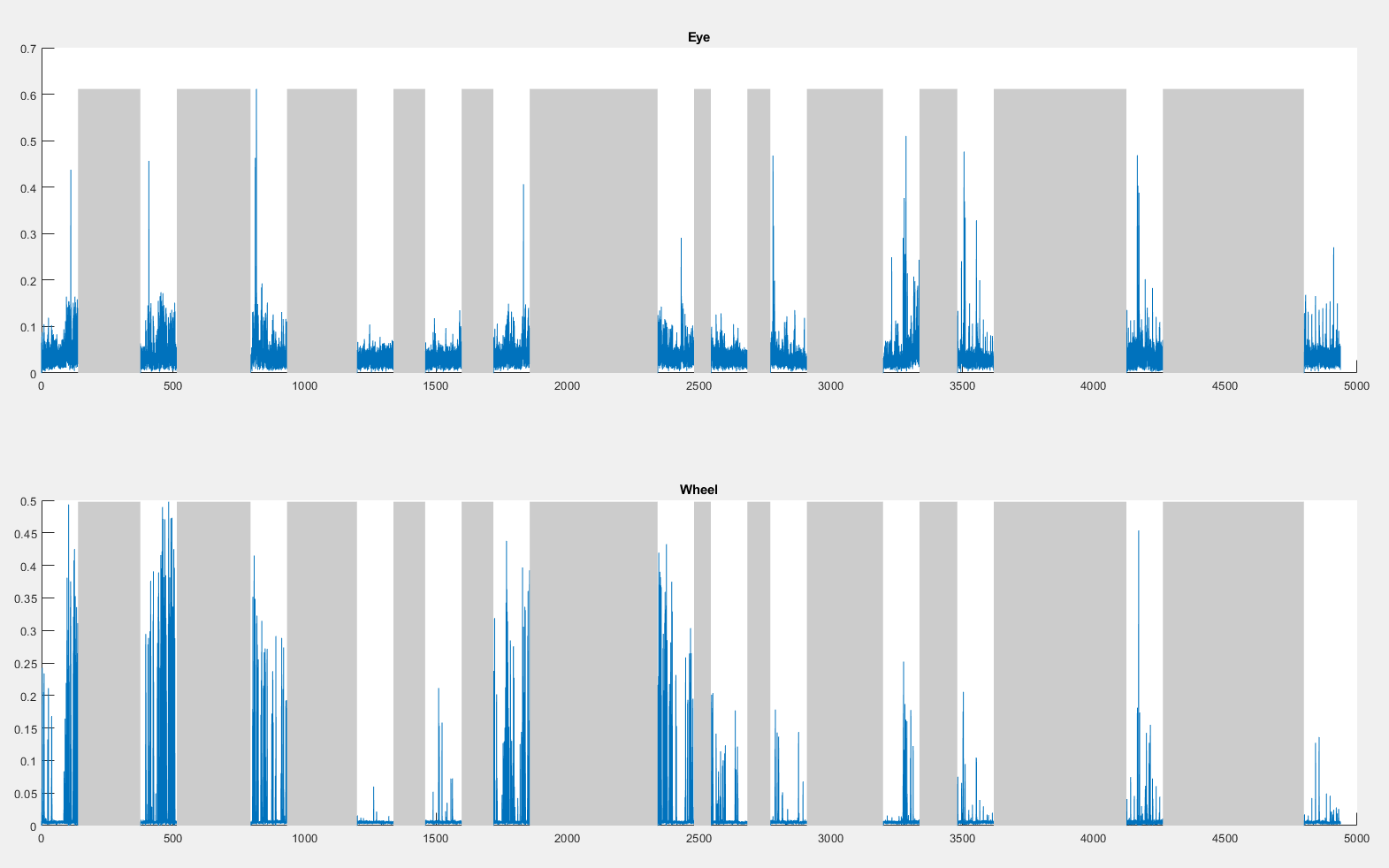
## Display extracted MIs

If you extracted all Motion indices, you should see a figure like this



For each MI, a plot of the whole experiment is displayed (time in seconds). Grey areas indicate gaps between recordings.

If you extracted multiple ROIs, you will see multiple subplot.



If you extracted the same ROI in different videos, they will be displayed in the same subplot, one colour per camera

# Scripted analysis

At any time, the database can be accessed and used for measurements. The most up-to-date version of the database is in

behaviour\_GUI.Experiment\_set

TO BE CONTINUED…