

The analysis of eye-tracking data using Python library PyTrack.

Supporting instruction for the video file.

The following topics will be covered in this instruction:

1. How to convert files we receive during an experiment with Eyelink Portable Duo, from EDF to ASC format, for further processing?
2. How to download required programs?
3. How to create a project in PyCharm?
4. How to upload the source data into the project?
5. How to conduct an analysis and view the results?

STEP 1

Download and install the required files and software. All software is free to use.

1. Python, version between 3.6.8 and 3.6.15.
(<https://www.python.org/downloads/release/python-360/>)
2. PyCharm integrated development environment.
(<https://www.jetbrains.com/pycharm/download/#section=windows>)
3. Eyelink developer toolkit to convert original files from edf. to asc. format.
(<https://www.sr-support.com/thread-13.htm>).

The default settings are for Windows users, additional instructions are provided for Mac users.

STEP 2

After installing all the required software, start converting the data files from edf. to asc. format. The Pytrack library works with input data in asc. format, therefore data files must be converted in advance.

On your computer, open the command line in the "Terminal" . (*On Mac, go to Programs - Utilities - Terminal*).

Use the following commands:

LS - to view the list of directories on the computer.

CD - to go to selected folder or directory

Please enter: **LS -> cd Desktop -> ls.**

Instead of "Desktop", add the directory where you stored the data files from the eye-tracking experiment.

You will see the number of edf. files in this directory. In the video example, we had two edf. files named "ws01.edf" and "ws02.edf".

To convert a file, type **EDF2ASC** in the Terminal and specify the file name. For example, **ws01.edf**

The conversion starts, and the file is saved in asc. format in the initial folder. In the video example, we did it with two files. So, type in **EDF2ASC ws02.edf** in the Terminal to convert the second file . repeat this command for every edf. file

STEP 3

Now you will create a project in Pycharm.

open Pycharm: File -> New project -> add name. Choose base interpreter Python 3.6. Uncheck "Create welcome script" -> and click Create.

After creating the project, we must move files into the project's folder.

In this case, the project's folder is in PycharmProjects -> Experiment.

"Experiment" is the name of the project used when creating for the purposes of this video. Please use the name of your project folder.

In this folder, you'll need to copy all the files from the archive, listed in the description box. You can download the files from the same source as this instruction and video file.

If you've downloaded them successfully, the following files will appear in our project:

- analyze.py
- experiment.json
- generate_format.py
- makefile
- poetry.lock
- preprocessing.py
- pyproject.toml

Next, add previously converted files in asc.format to "Input files" folder under your project. In the video example, these are "ws01.asc" and "ws02.asc".

When files are copied, they will appear in your Pycharm project. After successful completion of this step, start analysing of results.

STEP 4

The settings of this project are listed in the "**experiment.json**" script, this will be a configuration file . These are imperative to calculating statistics and visualising graphics.

Eye Tracker Basic Settings:

"EyeTracker": Sampling_Freq:
 Display_width:
 Display_height:
 aoi:

Parameters analysed during the experiment:

"EyeTracker": GazeLeftx;
 GazeLefty;
 GazeRightx;
 GazeRighty;

Pupilleft;
Pupilright;
FixationSeq;
GazeAOI.

The main settings to be changed for your project are Subjects - experiment participants:

«Subjects»:

«ws01»: «Gender:M»;
«ws02»: «Gender:F»;
etc.

There are only two participants in our example. If you need to count more participants for the project, copy and add them here sequentially. <<Gender>> is responsible for the participant's gender in the experiment. To ensure statistics are calculated correctly in the context of the participant's gender, this field is mandatory.

Video name in the experiment:

«Stimuli»:

«stimulus_0»;
«stimulus_1»;
«stimulus_2»;
etc.

There are 22 video files in our example, if you need to count more video sources, copy and add them here sequentially.

These are the main settings related to the eye-tracking experiment.

Now let's review the «**makefile**» script.

“Experiemnt_DIR=experiment” - is the directory that will be created and will store your results.
“Experiment_JSON_CONFIG=experiment.json” - is the link to the configuration file.
“INPUT_PATH=input_files” - is the folder with input files for analysis.

STEP 5

Download the required plugin:

Pycharm -> Preferences -> Plugins -> Search for «Makefile Language» -> press Ok.

Now it is time to open Terminal in PyCharm and set dependencies. Please type:

Pip install poetry

After installation, type:

Poetry install

All dependencies are set now.

! Information for Mac users only !

In the “Analyze.py” script, you type the following text:

Import matplotlib
Matplotlib.use("TkAgg")

The rest of the instructions are the same for Mac/Windows users.

In the “makefile” script click “Run_all” option and the files will start process. It will check asc.files for any errors and will clean up empty lines at the beginning of files (for instance, if pupil data was missing). The PyTrack library is sensitive to these kinds of errors. Therefore, we will remove them from our files. At the same time, “Start trial”/ “stop trial” parameters will also added in the files during this preprocessing.

In this case, it will perform the Preprocessing of files “ws01.asc” and “ws02.asc”

In the output, the results will show the number of lines deleted during the preprocessing due to the missing data.

For example,

```
Preprocessing file ws01.asc
211
Preprocessing file ws02.asc
56
```

Numbers *211* and *56* indicate the number of deleted lines with empty data at the beginning of the experiment. After preprocessing, the conversion of ASC to CSV format for the operation of our library begins and a directory with experimental data is created.

CSV files with results are kept in “Data” folder. All final results are saved into the same experiment folder on your computer. The files include information on saccades, fixations, blinks and pupil size.

After that the PyTrack visualization window will appear. You can view data at the group level (in our experiment, it is the “Gender”), or separately for each participant.

The following data visualization options are available:

- Gaze Heat Map;
- Fixation Plot;
- Live Plot.

Each picture can be saved by clicking on “Save Figure” button.

If you close the “PyTrack Visualization” window, accidentally, and want to open it again, you’ll need to relaunch statistics. To do so, go to a “makefile” script and click “run_analyze”. The statistics will be restarted and the window with visualisation will soon pop up.

This concludes the review of this library.

So far, you have learned:

- How to convert EDF files to ASC;
- How to create a project in PyCharm;
- How to copy files into a project;
- How to set up the configuration of your Eye Tracking project in “experiment.json” file;
- How to install dependencies in the Terminal;
- How to launch the “makefile” project;

- Where results are stored on a computer;
- How to build graphics and save them as a picture;
- How to restart a window with graphics.