

# User Manual

## User Manual

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## General information

Fishy Tracking is an application that allows the user to track multiple animals in video recording. The application takes a sequence of images and outputs a folder with the tracking data, the parameter used to produce the data and a log file. Fishy Tracking can operate on Linux, Mac, and Windows systems.

## Getting started

### Download

Stable versions of Fishy Tracking are released for Linux (installer or AppImage), MacOS (installer or dmg) and Windows (installer). Development versions are accessible from source and can be compiled for every system.

1. Stable versions

- Download the installer for your system at <http://fishytracking.benjamin-gallois.fr/download.html>.

2. Development versions

- Install OpenCV 4 on your system by following instructions at [https://docs.opencv.org/4.0.0/df/d65/tutorial\\_table\\_of\\_content\\_introduction.html](https://docs.opencv.org/4.0.0/df/d65/tutorial_table_of_content_introduction.html).
- Install Qt5 on your system by following instructions at <http://doc.qt.io/qt-5/gettingstarted.html#offline-installation>.
- Download Fishy Tracking code source at <https://git.benjamin-gallois.fr/bgallois/FishyTracking>.
- Referred to the developer user guide to compile the project.

## Installation

1. With Fishy Tracking installer:
  - Executes the installer and follows instructions.
2. With Linux AppImage:

Allows FishyTracking.appimage to be executed:

- Right click on the AppImage file.
- Click on properties.
- Click on permissions.
- Check "allow executing the file as a program".

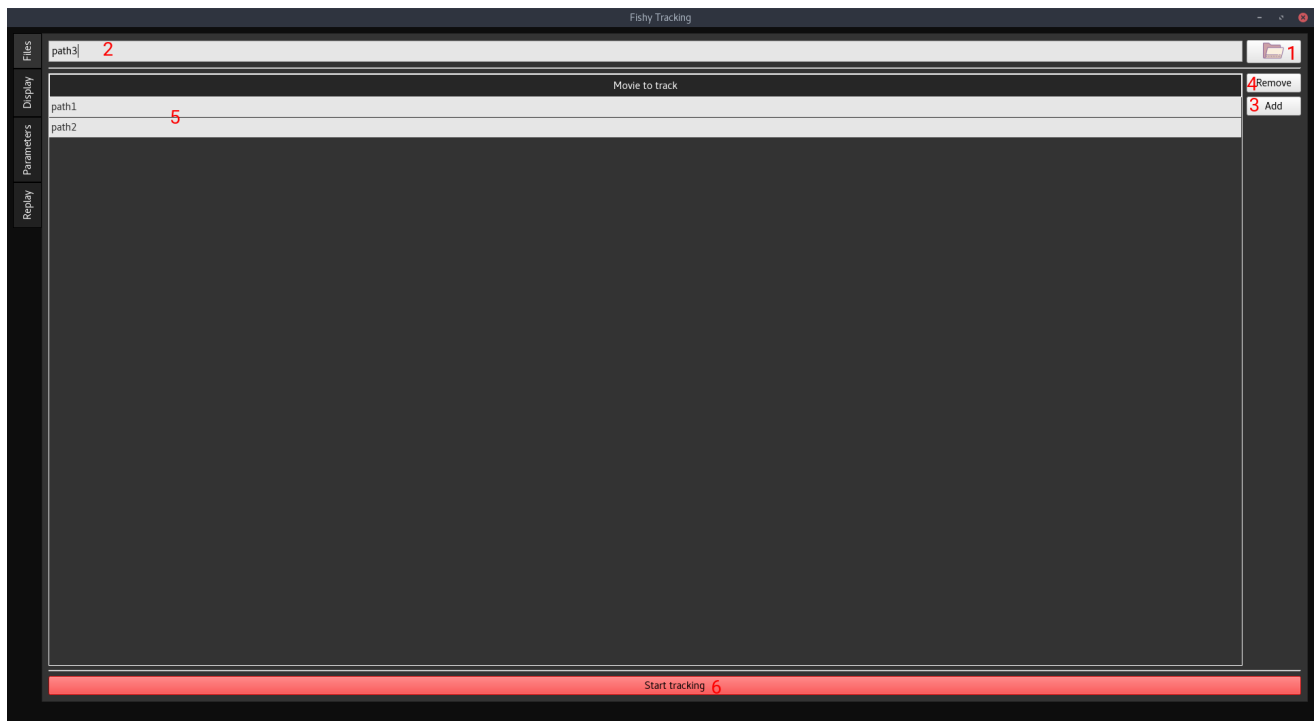
## Software overview

### Files panel

The files panel allows the user to add paths to folders where the images sequence to analyze are stored. Multiple paths can be added to analyze data in a bunch.

How to add movies to analyze?

1. Add the path to the folder where the images sequence is stored:
  - Click on the (1) button to select a folder or copy the folder path to (2) the path bar.
2. Click on the (3) button to add the path to the list of movie to analyze.
3. Remove a path if necessary by selecting it in the (5) path table list and by clicking on the (4) button to remove the path.
4. Start the analysis by clicking on the (6) button start.



## Display panel

The display panel shows the current analysis process by displaying the binary image (1) and the tracking image (2). The tracking can be extremely fast, to review the tracking please referred to the replay panel.

## Parameters panel

The parameters panel provides a mean to change the tracking parameters before or during analysis. We recommend finding a set of parameters by changing parameters one by one and controlling effects in the display panel. When an optimal set of parameters are found, restart the analysis. An interactive help to determine some parameters is available by clicking on the help button (1).

All parameters are saved and reloaded at each closing and opening of the program.

Parameter	Range	Description
Dilatation	0 to inf	Dilates detected objects. Sets to 0 for not dilatation.
Registration	yes, no	Registers images.
Light background	yes, no	yes: dark objects on light background, no: light object on dark background
ROI bottom y	0 to image height	0: no ROI. y-coordinate of the bottom right corner of the rectangle ROI.

Parameter	Range	Description
ROI bottom x	0 to image width	0: no ROI. x-coordinate of the bottom right corner of the rectangle ROI.
ROI top y	0 to ROI bottom y	0: no ROI. y-coordinate of the top left corner of the rectangle ROI.
ROI top x	0 to ROI bottom x	0: no ROI. x-coordinate of the top left corner of the rectangle ROI.
Number of images background	1 to number of images in the image sequences	Number of images to average to compute the background. The images are taken at equal interval in the images sequence.
Arrow size	2 to inf	Size of the arrow displayed on the object in the tracking image in the display panel.
Maximal occlusion	0 to inf	Maximal distance in pixels that an object can travel when occluded.
Weight	0 to 1	Weight between difference in displacement or difference in direction to compute the cost (see matching method).
Maximal angle	0 to 360	Angle in degree that an object can change between two frames (see matching method).
Maximal length	0 to inf	Length that an object can travel between two frames (see matching method).
Spot to track	0, 1, 2	0: head, 1: tail, 2: body. Body part parameters (position and angle) used for the matching process (see matching method).
Binary threshold	0 to 255	Threshold value that separate background and foreground.
Minimal size	0 to maximal size	Minimal size in pixels of the tiniest object to track in the images sequences.
Maximal size	minimal size to inf	Maximal size in pixels of the biggest object to track in the images sequences.
Object number	1 to inf	Number of object to track.

## Replay panel

The replay panel allows the user to open and see the result of a tracking analysis and to correct the tracking if errors are detected.

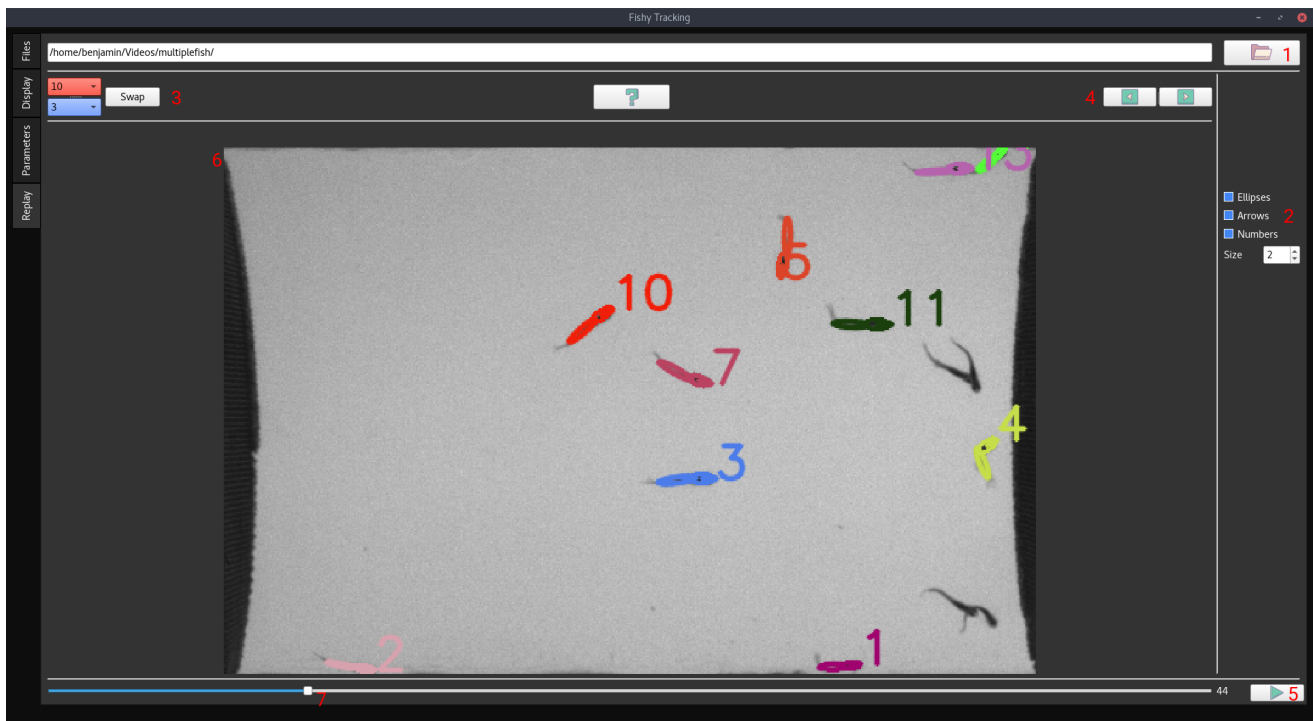
### Open a tracking analysis

1. Clicks on the (1) button to open a folder where an images sequence previously analyzed is stored.
2. The images sequence is displayed in the (6) screen and can be played by clicking on the (5) button or by moving the (7) cursor.
3. You can change display option with (2) tick-boxes.

### Correct errors

To correct a tracking error (mismatching between two objects):

1. Get to the frame where the error occurs:
  - By playing the image sequence and visually identify errors.
  - By clicking on (4) buttons to go to previous and next occlusion events where mismatching are the most probable to occurs.
2. Left click on the first object or select the number of the first object in the (3) box. The box displays the number and the color of the selected object.
3. Left click on the second object or select the number of the second object in the (3) box. The box displays the number and the color of the selected object.
4. Right click on the (6) image or click on the (3) swap button to swap the two objects from the image displayed to the end of the images sequence.



### Correct rapidly a tracked images sequence

Mouse and keyboards shortcuts are provided to the user to rapidly correct a tracked images sequence.

For AZERTY keyboard:

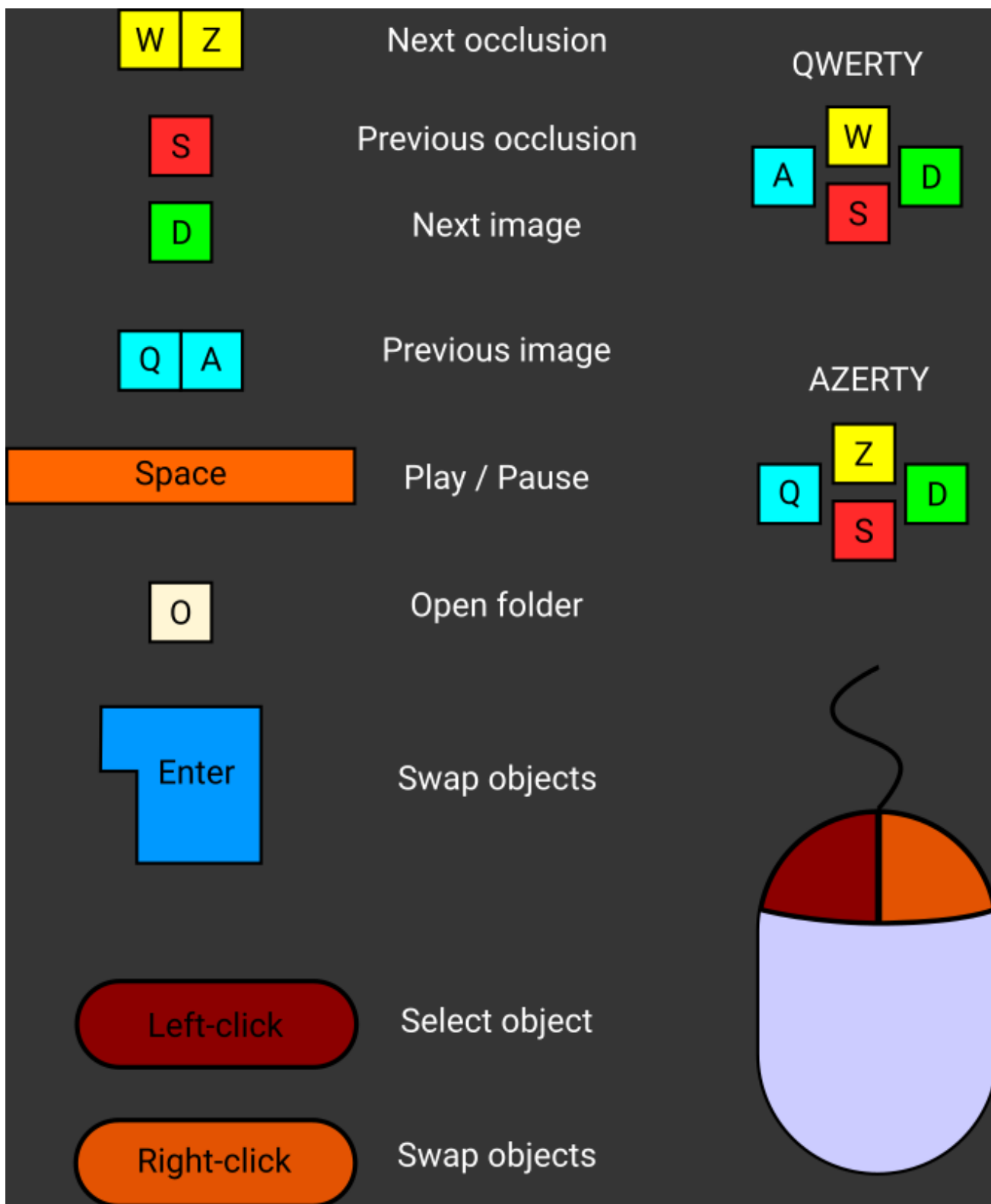
- Next image: Z
- Previous image: S
- Next occlusion: Q
- Previous occlusion: D
- Play: Space

For QWERTY keyboard:

- Next image: W
- Previous image: S
- Next occlusion: A
- Previous occlusion: D
- Play: Space

Mouse shortcuts:

- Left click to select objects.
- Right click to swap objects.



## Input files

Fishy Tracking analyzes images sequence. "pgm", "png", "jpeg", "jpg", "tiff", "tif", "bmp", "dib", "jpe", "jp2", "webp", "pbm", "ppm", "sr", "ras", "tif" image formats are supported.

If you have recording in a video format, you need to convert it into images sequence as follow.

1. For Linux, windows, and mac in command lines:
  - Install ffmpeg.
  - In a terminal type: `ffmpeg -i video.webm image-%03d.png`
2. For Linux, windows, and mac in graphical:
  - Use Handbrake: <https://handbrake.fr/> or ImageJ.

## Output files

When an analysis is started, Fishy Tracking creates a folder named Tracking\_Result containing:

- tracking.txt containing the tracking data (in the frame of reference of the full image with the origin in the top left corner) as following:

xHead	yHead	tHead	xTail	yTail	tTail	xBody	yBody	tBody	Curvature	ImageNumber	headMajorAxisLength	headMinorAxisLength	tailMajorA
x coordinate of the head. Object 1	y coordinate of the head. Object 1	Angle of the head. Object 1	x coordinate of the tail. Object 1	y coordinate of the tail. Object 1	Angle of the tail. Object 1	x coordinate of the body. Object 1	y coordinate of the body. Object 1	Angle of the body. Object 1	Curvature. Object 1	Image number. Object 1	Length of the major axis of the head equivalent ellipse. Object 1.	Length of the minor axis of the head equivalent ellipse. Object 1.	Length of the tail equivalent ellipse. Object 1.
x coordinate of the head. Object 2	y coordinate of the head. Object 2	Angle of the head. Object 2	x coordinate of the tail. Object 2	y coordinate of the tail. Object 2	Angle of the tail. Object 2	x coordinate of the body. Object 2	y coordinate of the body. Object 2	Angle of the body. Object 2	Curvature. Object 2	Image number. Object 2	Length of the major axis of the head equivalent ellipse. Object 2.	Length of the minor axis of the head equivalent ellipse. Object 2.	Length of the tail equivalent ellipse. Object 2.
x coordinate of the head. Object 1	y coordinate of the head. Object 1	Angle of the head. Object 1	x coordinate of the tail. Object 1	y coordinate of the tail. Object 1	Angle of the tail. Object 1	x coordinate of the body. Object 1	y coordinate of the body. Object 1	Angle of the body. Object 1	Curvature. Object 1	Image number. Object 1	Length of the major axis of the head equivalent ellipse. Object 1.	Length of the minor axis of the head equivalent ellipse. Object 1.	Length of the tail equivalent ellipse. Object 1.
...	...	...	...	...	...	...	...	...	...	...	...	...	...

Note: if you want to extract the data for a particular object:

$$data_i = (objectNumber) * imageNumber + objectNumber$$

with objectNumber the object number {1, 2, 3, ...}, imageNumber the image number {0, 1, 2, ...}.

- parameters.txt containing the set of parameters at the beginning of the analysis, changes during the analysis are not saved.

## For developers

A complete API and developer documentation is available. It can be generated for the latest version of Fishy Tracking by executing `./generateDocumentation.sh`. A folder Documentation is created with the developer documentation.

## Performance

The performance can vary with the selected parameters. Registration and dilatation can cause a loss of 50% in performance. The number of objects influences the performance as the cube of the object number.



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