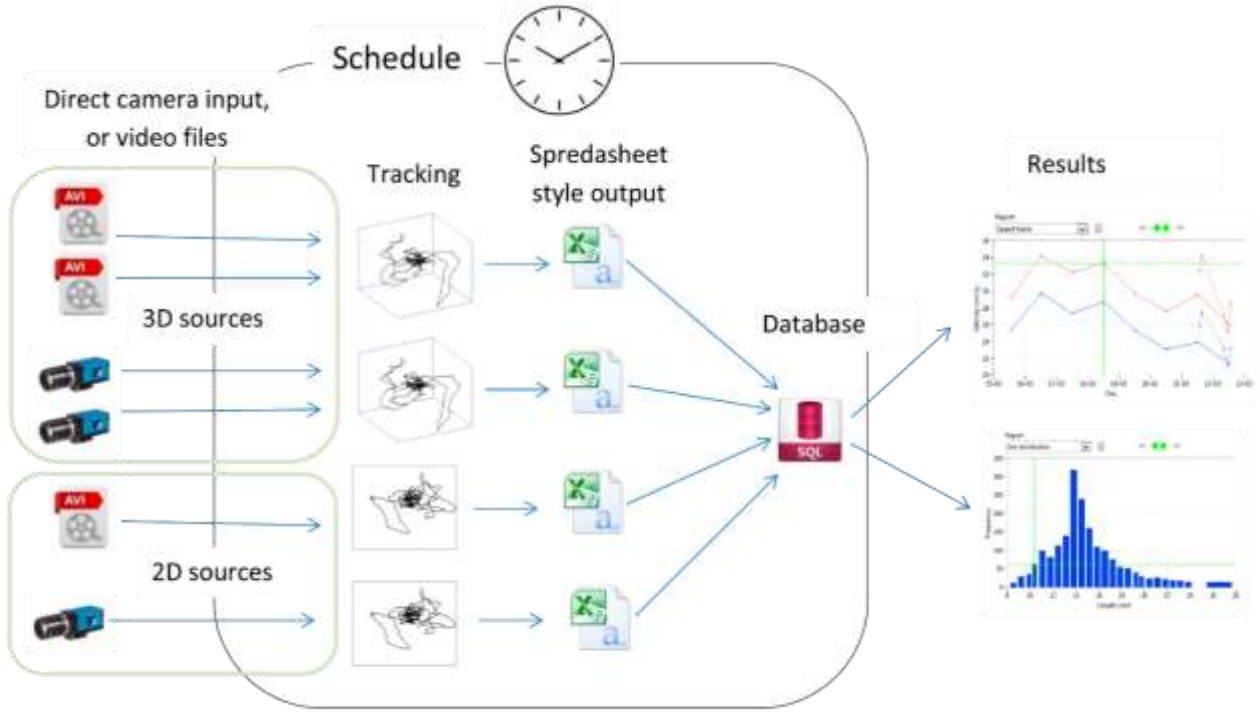
LABTRACK HELP

About LabTrack

LabTrack by BIORAS, Denmark

LabTrack is a program for tracking moving objects. It can analyze video online (video streams in real time) or offline (saved video sequences). Signals from an array of cameras can be analyzed simultaneously. Output is saved in spreadsheet style, and includes X, Y, Z coordinates for each organism and data point, ID and size of each individual organism/object. LabTack can connect to a SQL database and automatically import data. This is a powerfull too for extracting data from large datasets.



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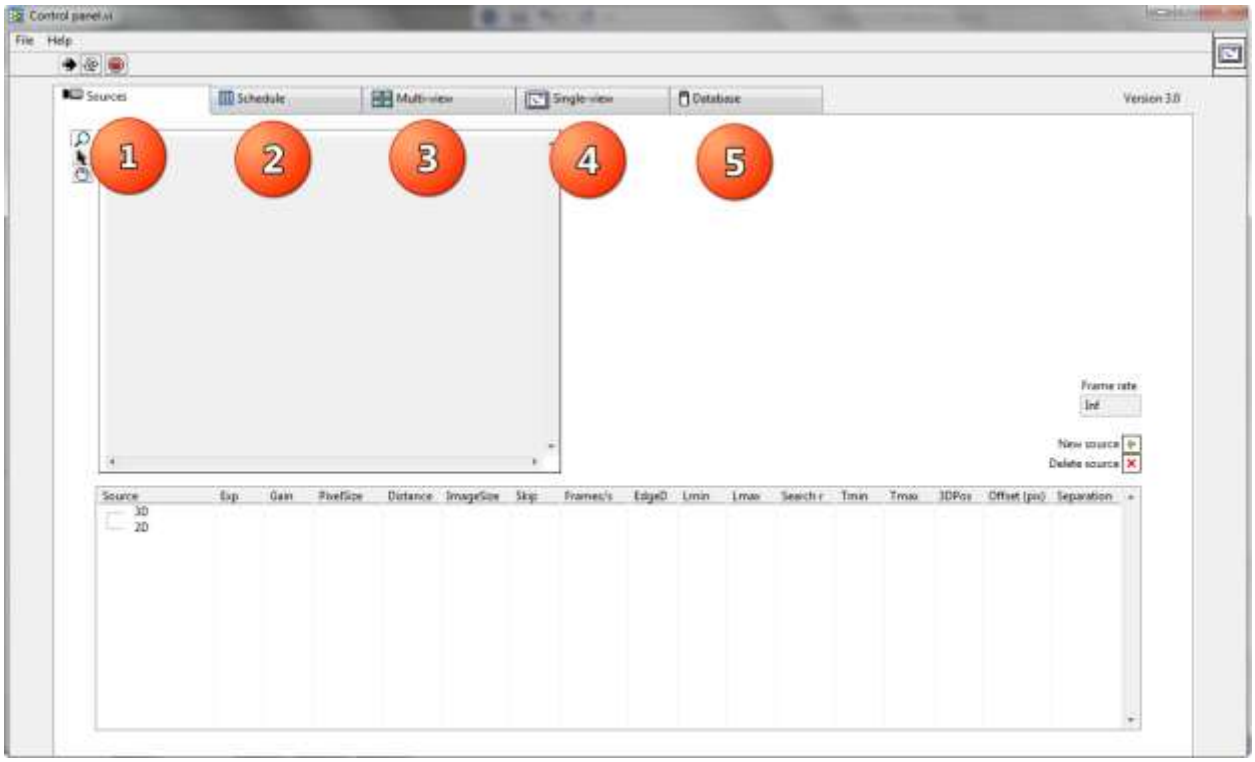
Open LabTrack

Open the application from the Programs menu. The first time LabTrack is opened, the program will open with an empty Front panel.

The application consists of five tabs:

1. “Source” for defining the source of the video stream (direct camera input, or saved video files).
2. “Schedule” for scheduling the video analysis to enable analysis of multiple streams and repeatedly at fixed intervals if required.
3. “Multi-view” is a panel for viewing 4 videos at the same time.
4. “Single-view” for viewing one video in a larger frame.
5. “Database” tab for database reports.

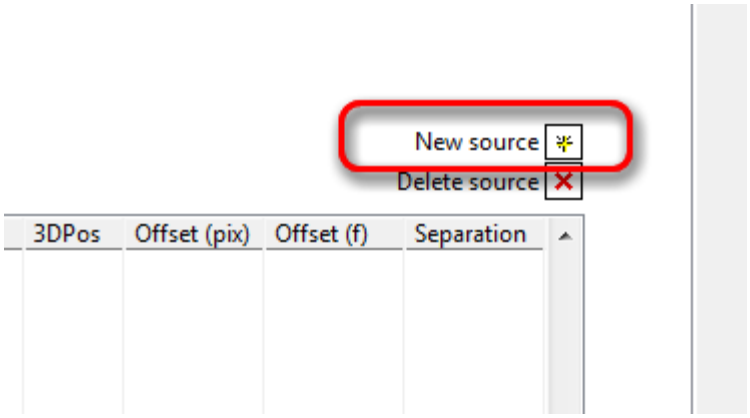


Sources: Select cameras or video sources

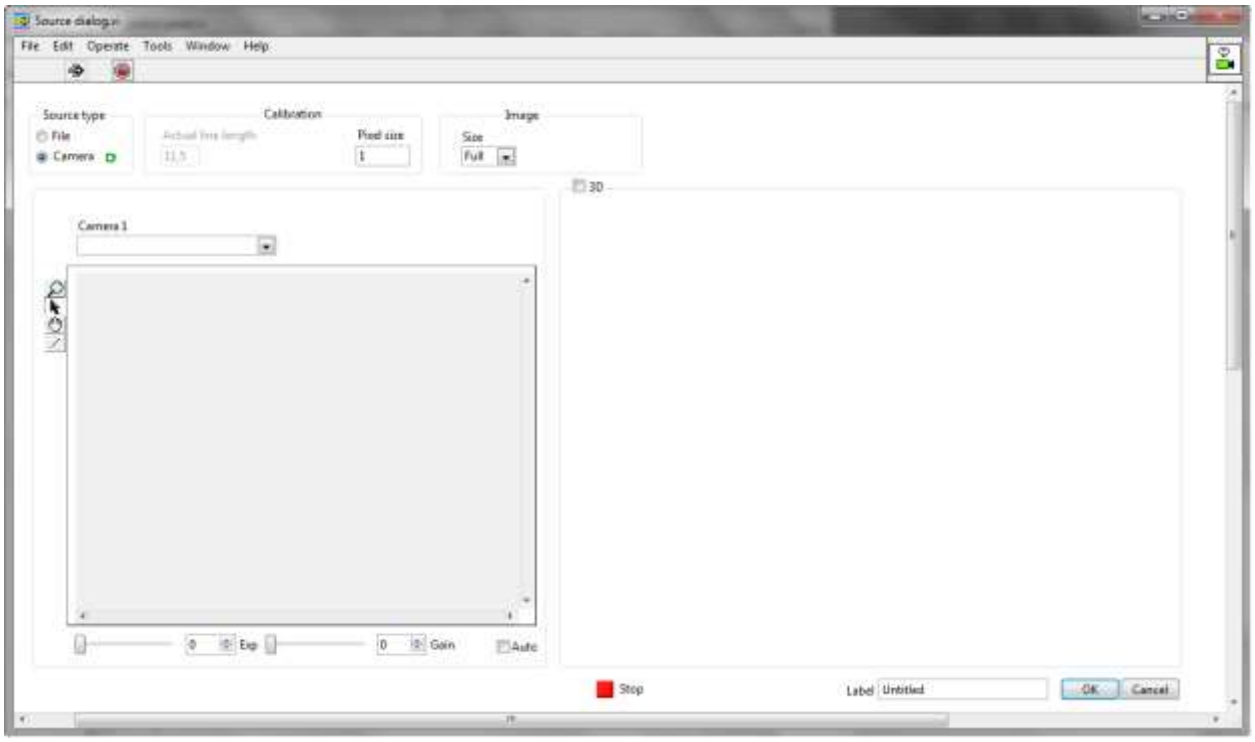
Click on the Source tab to add a new source or to view or edit existing sources.

Add a new source

Click the ”New Source” button:



The Source dialog window will appear:



Selecting a camera as the source

1. Set the source type to camera
2. Select the camera from the list. If it does not appear, try clicking on the adjacent refresh button.

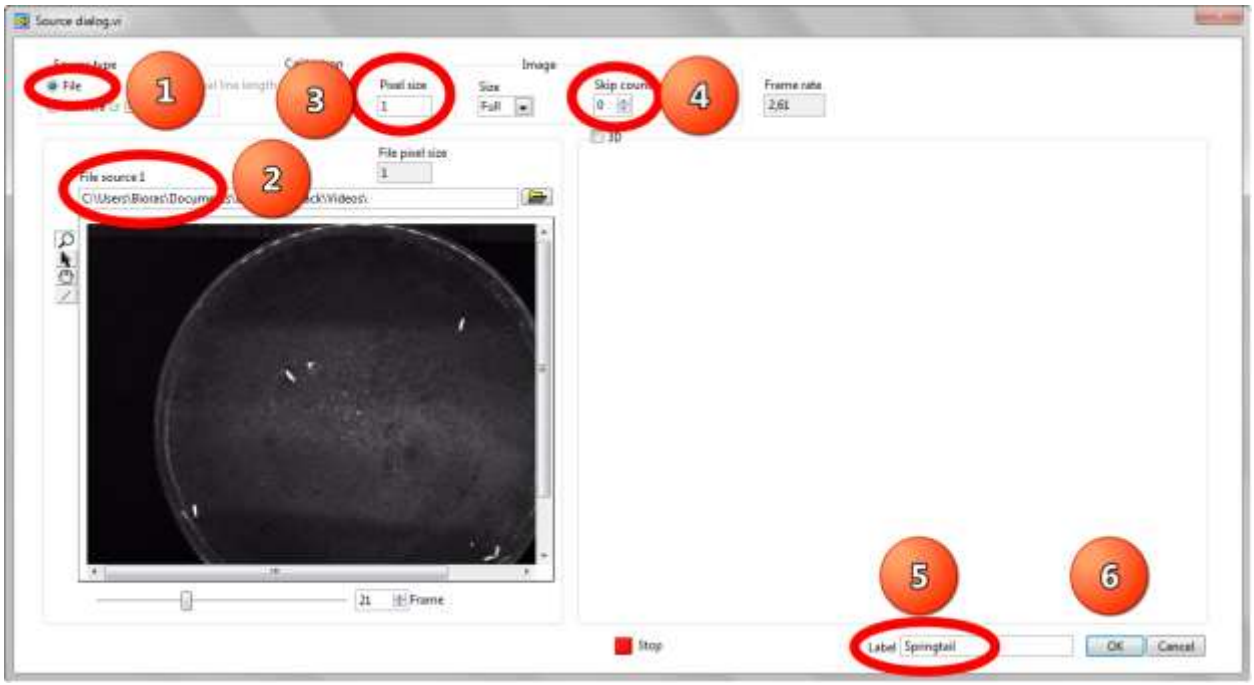
   Camera ; Refresh button: , show camera attributes:

   NOTE: *Only GenICam compatible cameras and cameras from The Imaging Source are currently supported*
3. Define the pixel size (see the calibration section below).

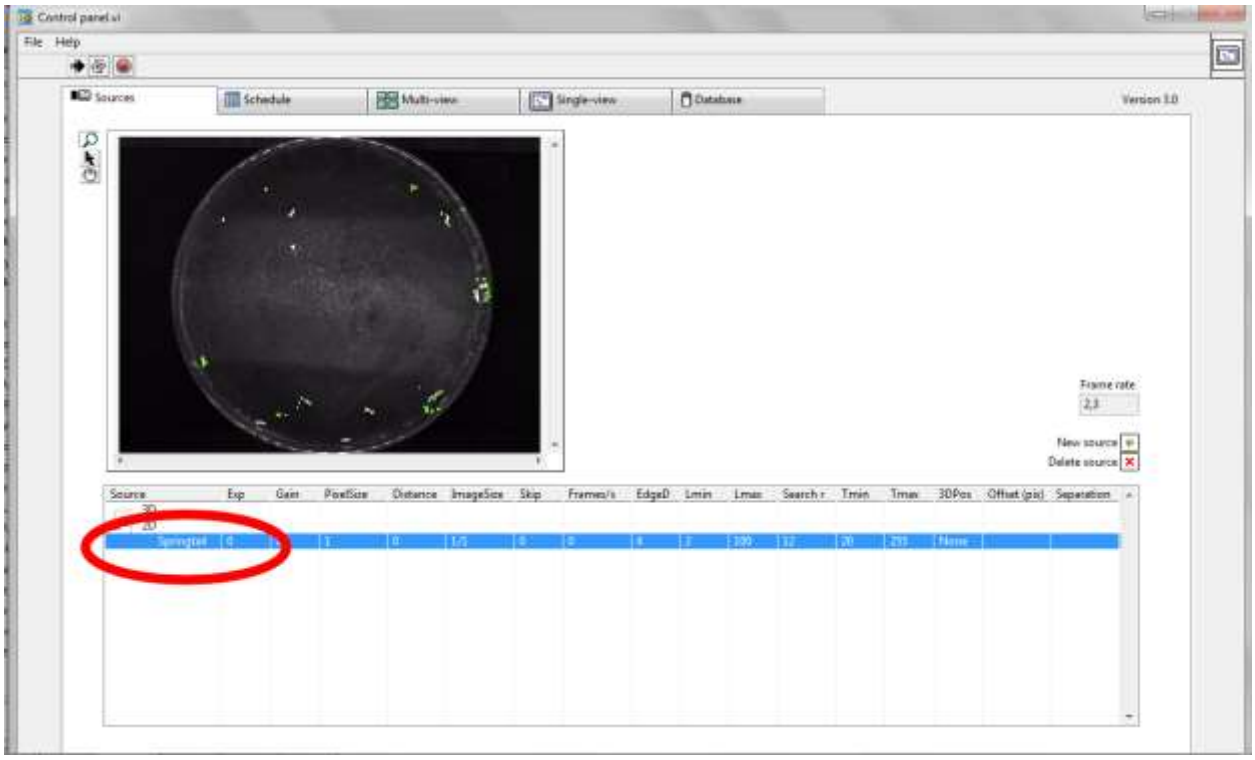
4. Optionally choose to reduce resolution in the Size control. A lower resolution will reduce bandwidth requirements if the camera supports binning and it will increase the potential analysis speed.
5. Add a label in the Label field to the lower right.
6. Click OK, and the video source has been added to the Source list in the Control panel window.

Selecting a video file as the source

1. Source type: Choose “File”
2. Select a video file. Only .avi files are supported.
3. Define the pixel size (see below in the calibration section). If the file has been generated by LabTrack, the pixel size defined at recording time will appear above the image for reference
4. Specify a skip count to speed, if required. This is typically used if movement is very slow in relation to the recorded frame rate.
5. Add a label in the Label field to the lower right.
6. Click OK, and the video source has been added to the Source list in the Control panel window.

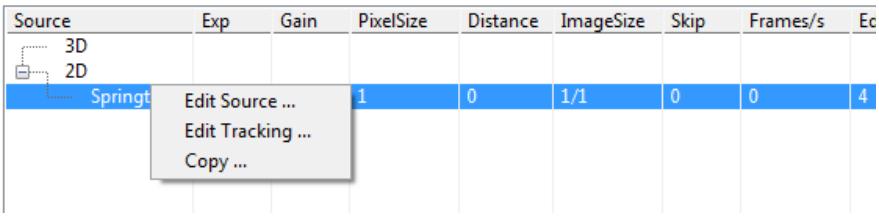


The video source has been added to the Source list in the Control panel window:



Edit an existing source

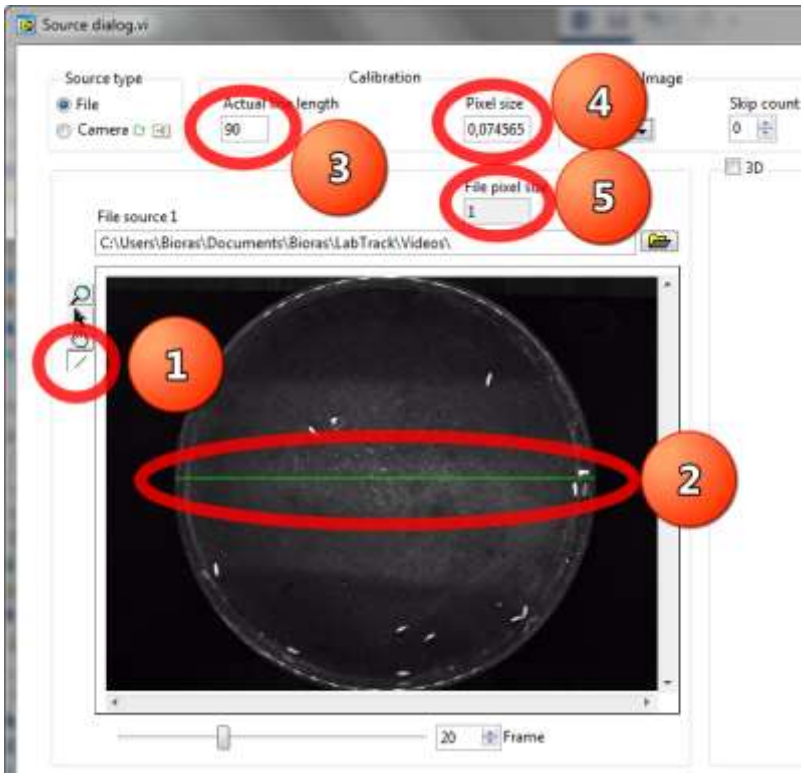
Right click on the source and select “Edit Source” from the short cut menu.



Calibration of Pixel size (2D)

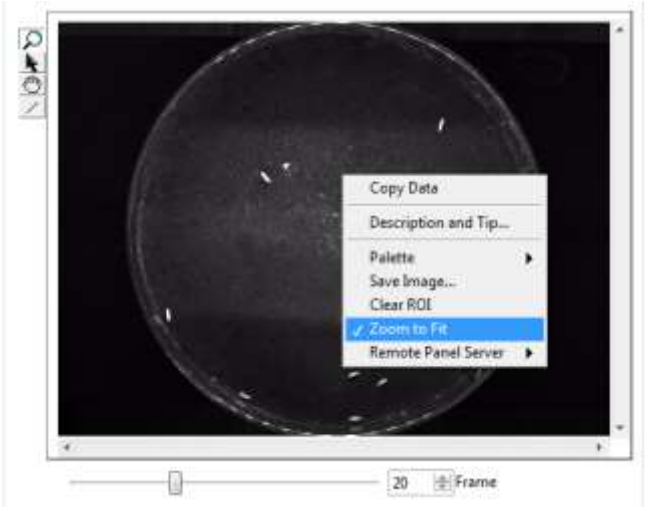
Calibrate by measuring an object of known size with the line tool, in the example below the diameter of a petri dish (90 mm) is used for calibration.

1. Select the line tool
2. Draw a line across an object of known size. The line tool draws a green line, as shown below.
3. Write the length in the Actual line length field in the units of your choice (e.g. 90 mm).
4. The Pixel size will automatically be calibrated.
5. The pixel size can also be added directly into the Pixel size field. (Remove in graphics)



Zoom in or out on video panel

Zoom the image window by using the looking glass tool or right click the display window to fill the display window, and select Zoom to fit:



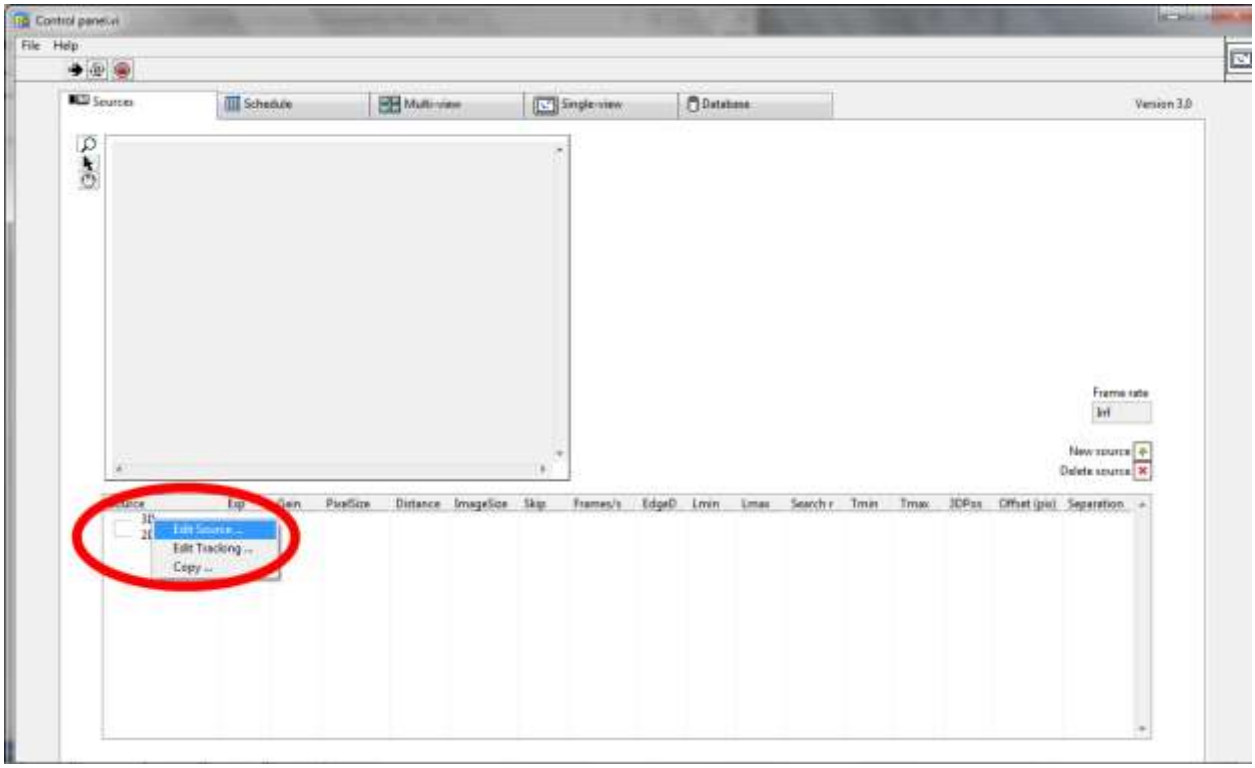
Enlarge image by clicking anywhere in the video frame using the looking glass tool

Reduce image size by selecting the looking glass tool, holding the shift button down, and click anywhere in the video frame

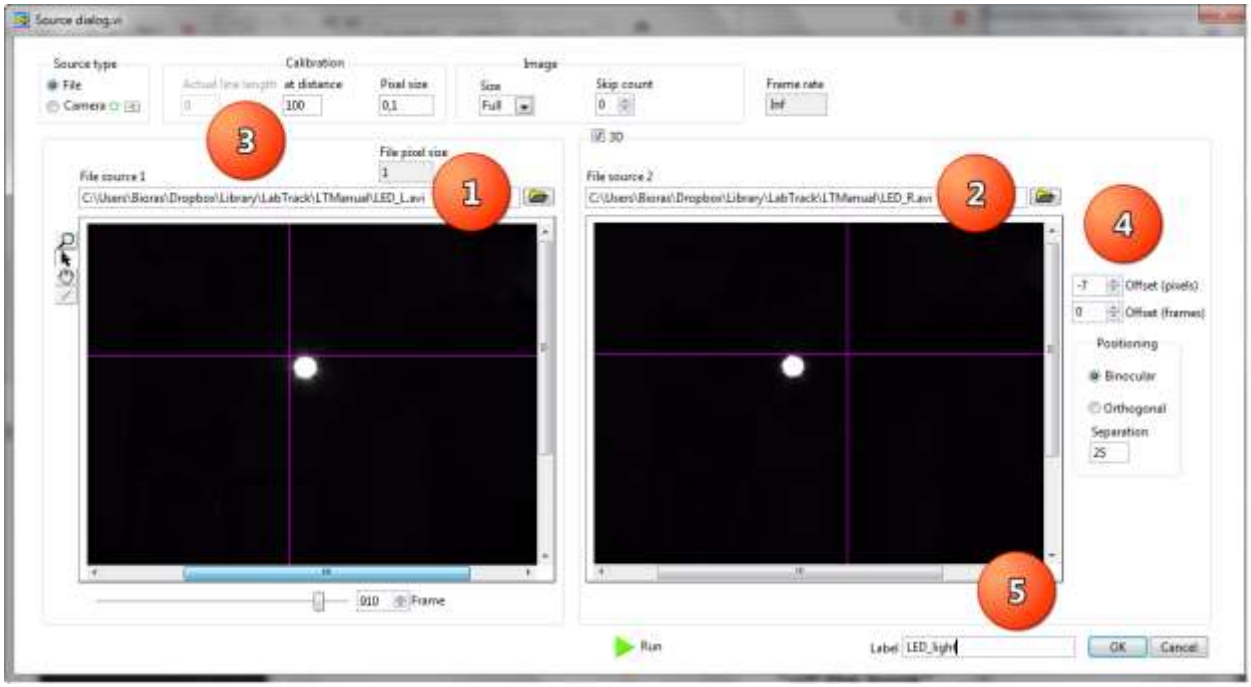
Defining 3D sources

Select 3D video source

In the LabTrack Control panel **right click** in the sources window, and select **Edit Source**.



The source dialog window will appear:

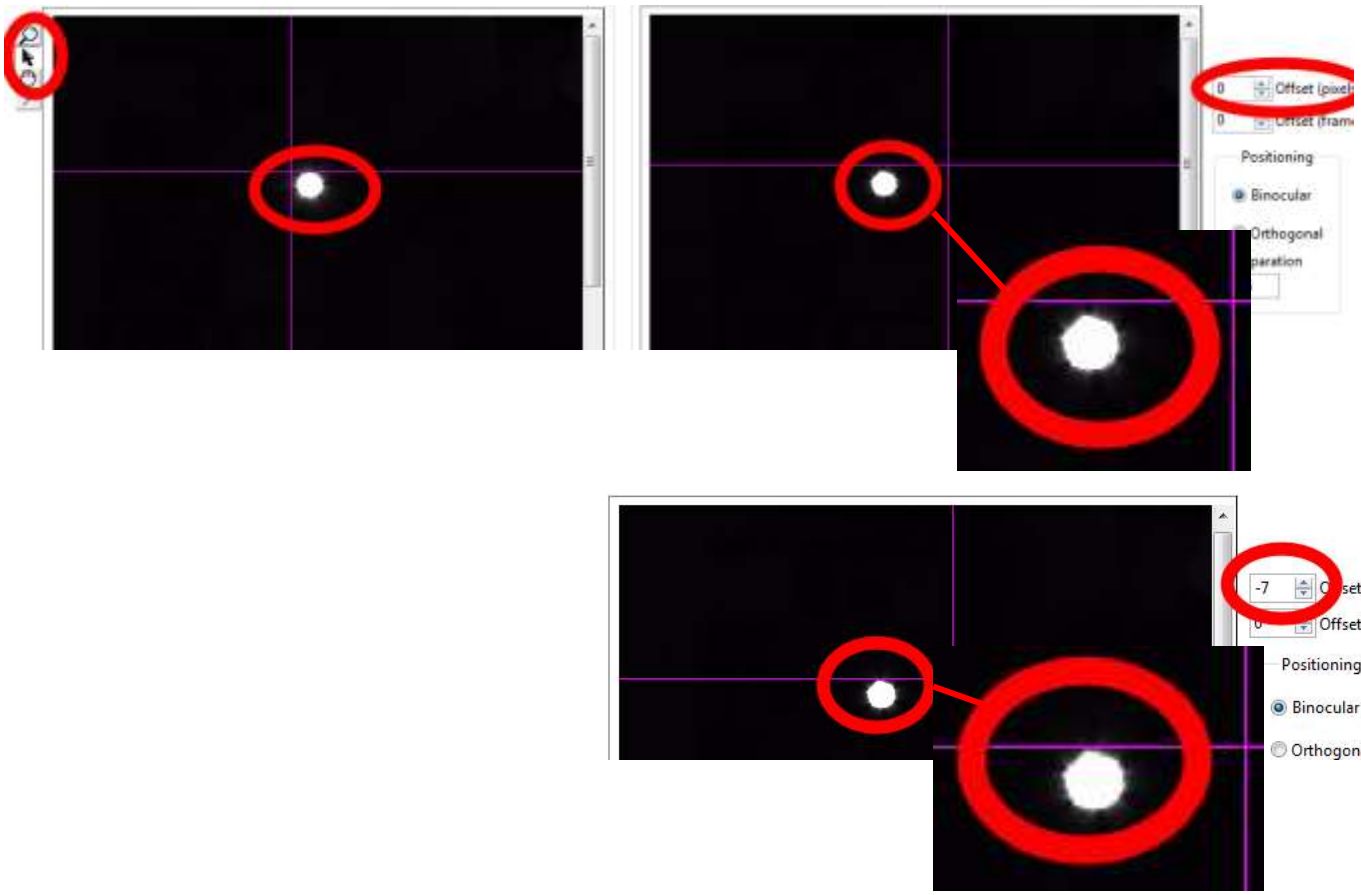


1. Select the left video or camera source
2. Select the right video or camera source
3. Calibrate the pixel size as explained above
4. Adjust the offset

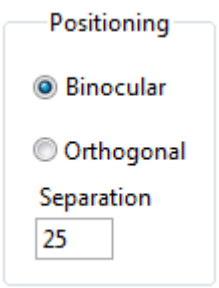
The cameras might be slightly vertically offset. A stereo video of an object will show the offset.

- Select the arrow tool
- In the left video frame, click on the upper or lower edge of an object that is visible both left and right.
- A purple line will appear in both the left and right hand camera.
- The offset is the distance between the object and the purple line
- Adjust the offset In the Offset pixel field. In this example the offset was -7

Left video frame *Right video frame*



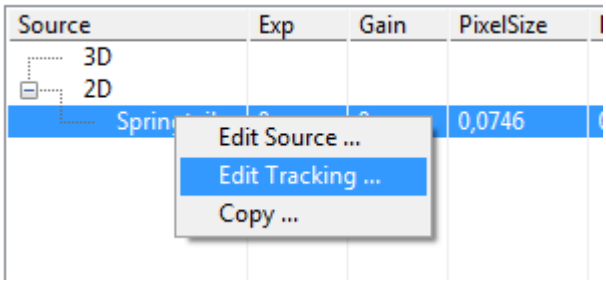
For binocular (parallel) 3D cameras set the separation between the cameras. In the example below the separation was 25 cm:



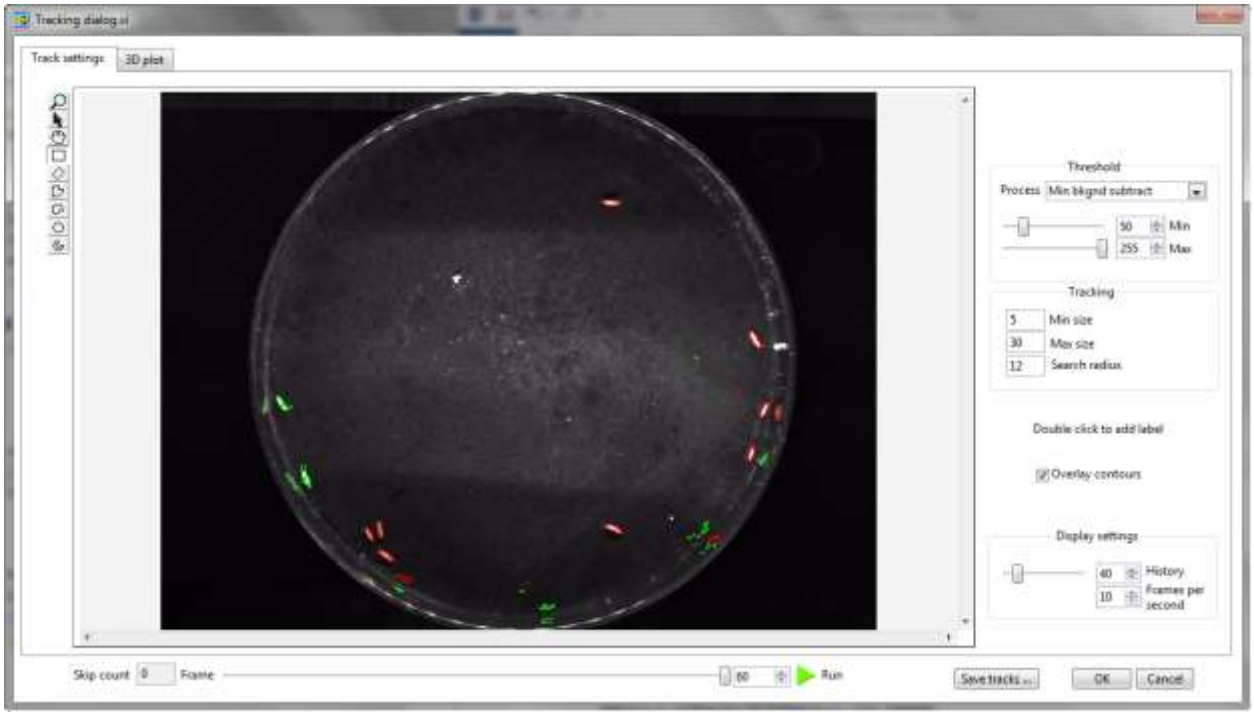
5. Write a label in the Label field. Click OK

Define or edit tracking settings

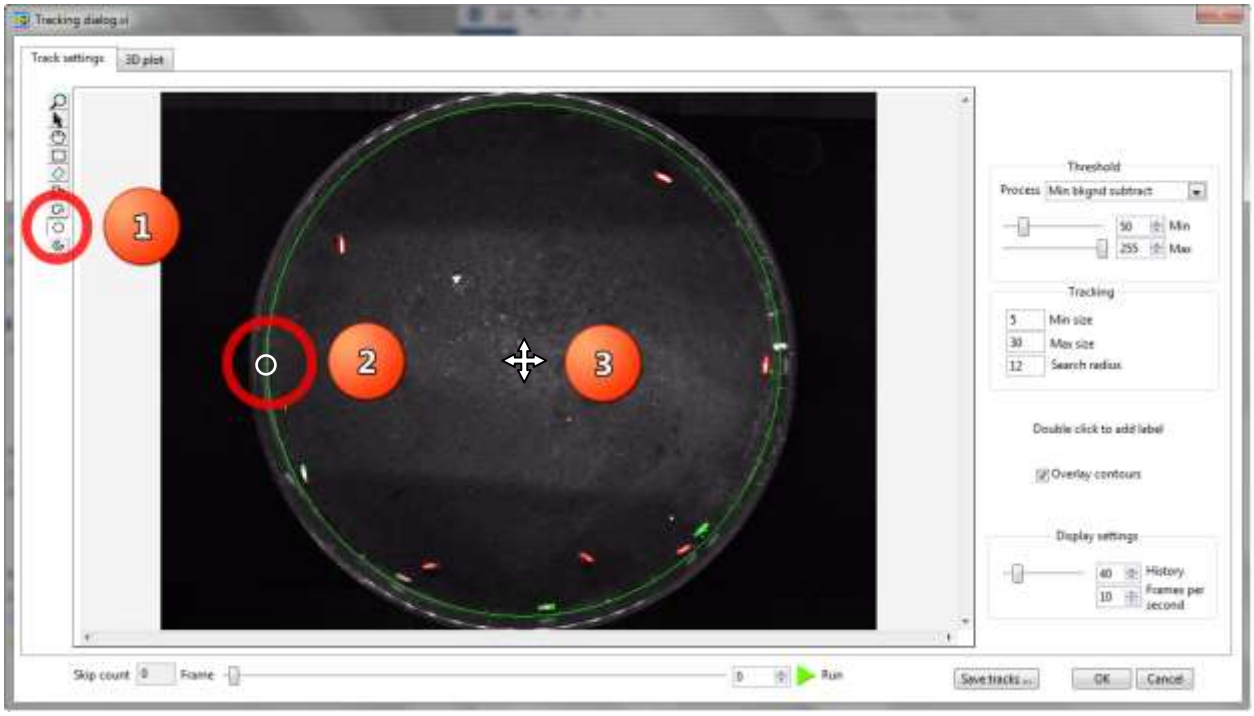
Right click on the video source line, and choose Edit tracking:



The Tracking dialog window will appear:



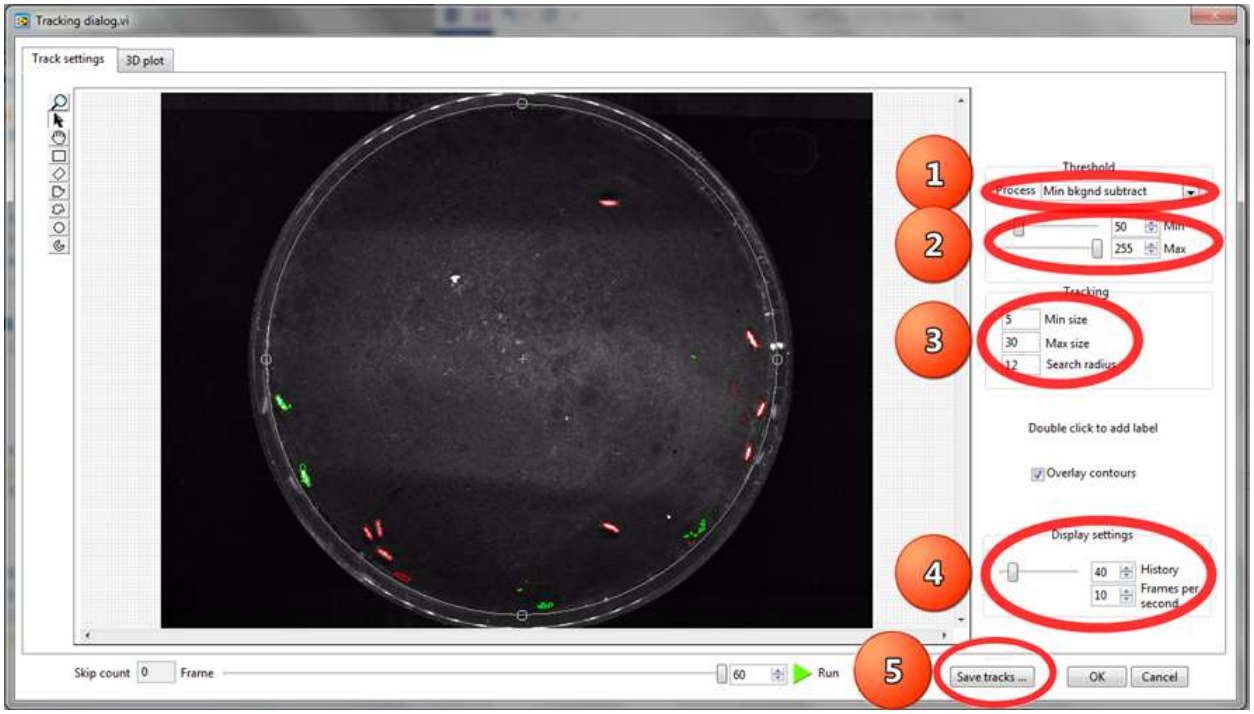
Define Area of Interest



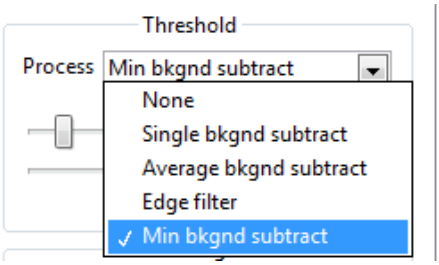
If a limited area should be analyzed:

1. Choose one of the shape tools (here the circle shape) on the left hand side of the picture frame.
2. Draw a frame around the area of interest, which will be the area for tracking analysis. Adjust the shape size by holding the mouse over the shape edge and clicking on the small circle that appears. Multiple regions can be selecting by holding the ctrl button down while drawing.
3. Move shape by clicking anywhere inside the shape and moving the circle.

Adjust the Tracking parameters



1. Threshold method and settings



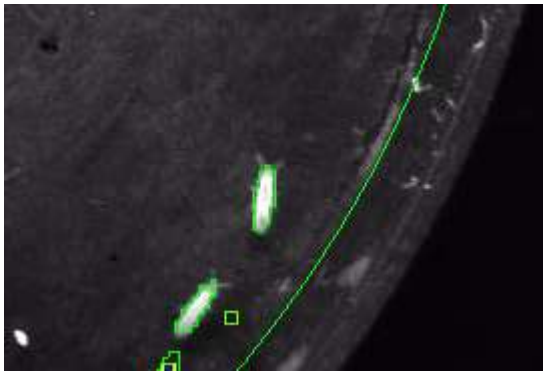
There are 5 different threshold methods:

- **None**: Simple threshold. This works well if there is strong and even contrast between objects and the background. It will allow tracking very slow (or stationary) objects.
- **Single background subtract**: first frame is subtracted. This works well if the background is completely static and moving objects are not yet visible or at least few and dispersed.
- **Average background subtract**: Continuously subtracts the average of blocks of 64 video frames. In this way all moving objects should be faded out of the averaged image. This method only works if objects are moving fairly rapidly.
- **Edge filter**: Uses edge strengthening algorithms for highlighting objects and making it easier to select a threshold. This method is suitable for videos without complicated background disturbances, and where objects have low contrast against a uniform background
- **Min bkgrnd subtract**: Preferred option! Minimum background subtraction uses a statistical model to define the background and works well for tracking moving objects against an uneven background.

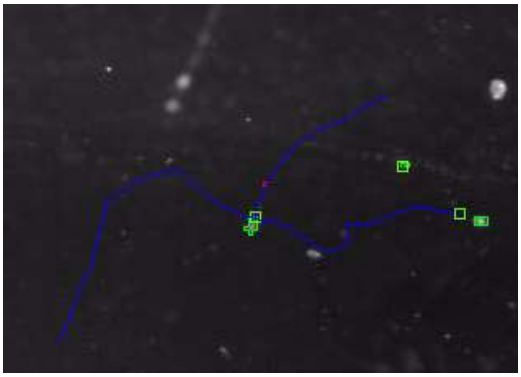
2. Set the Tracking threshold value

Select Threshold for Min bkgrnd subtract

The optimal Minimum threshold value depends on the contrast between the background and the tracked organisms. The Max value will typically be 255 for most methods, and the Min value sets the sensitivity.

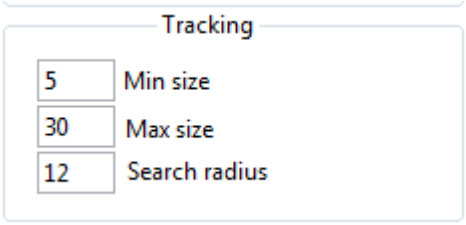


Organisms with good contrast require a high threshold value. In this example the threshold = 60



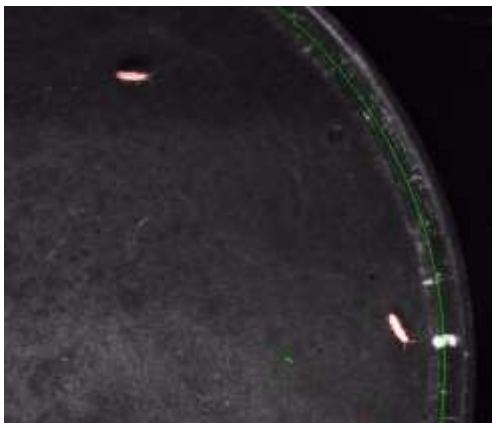
Organisms with weak contrast require a lower threshold value. In this example the threshold = 20

3. Set the organism size and search radius

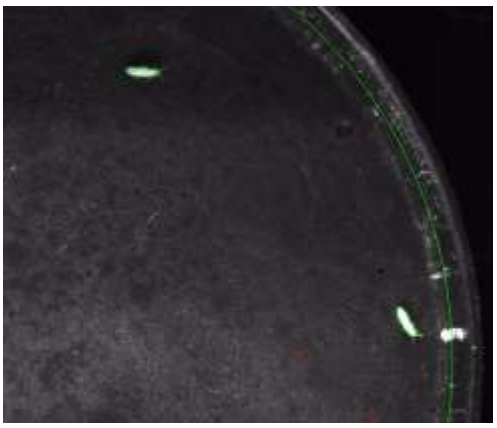


Min size, Max size: Minimum and maximum length (in pixels) of organsims/particles that should be tracked. Organisms or particles within the size limits will be drawn with a green edge around them when "Overlay contours" is checked. Organisms or particles outside the size limits will be drawn with a red edge around them.

Search radius: The radius in pixels from the current track heads within which searches are conducted for track continuation. The default search radius is set to 12 pixels.

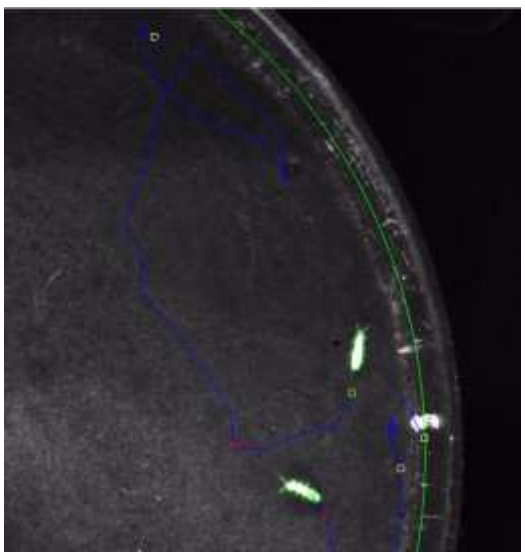


Min size = 5, Max size = 30 (length of organisms in pixels). The organisms were outside the size range and are shown with a red line around them,

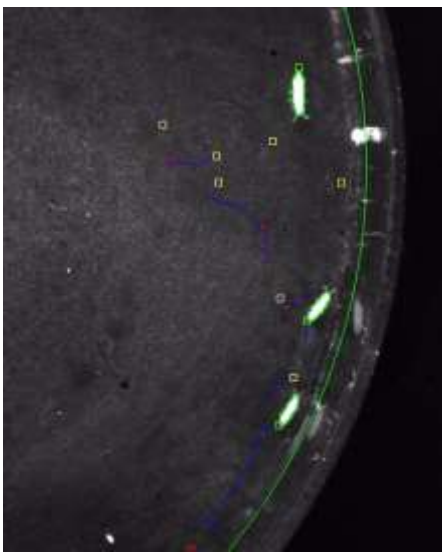


Min size = 20, Max size = 100. Organisms were within the size range, as shown by the green line around them.

The search radius depends on the speed of the organism. If the search radius is set too low the tracks will be broken, if the search radius is too high tracks might get mixed. The blue lines are tracks, and a green square at the end of the line indicates an active track, a yellow square indicates a track which has ended, either temporarily or permanently. See the example below (Springtails in a petri dish).

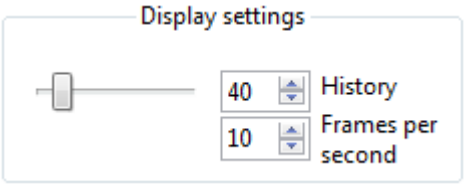


Search radius = 30, unbroken tracks and suitable for this organism

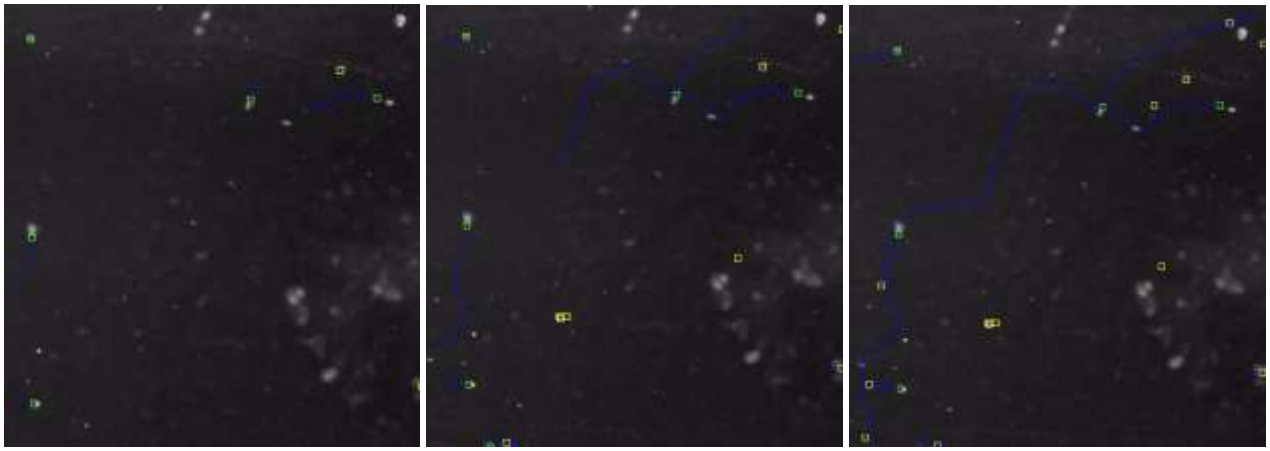


Search radius = 12 was to low and resulted in broken tracks

4. Display settings



History control is the number of frames over which tracks are displayed. History will not influence the saved data.



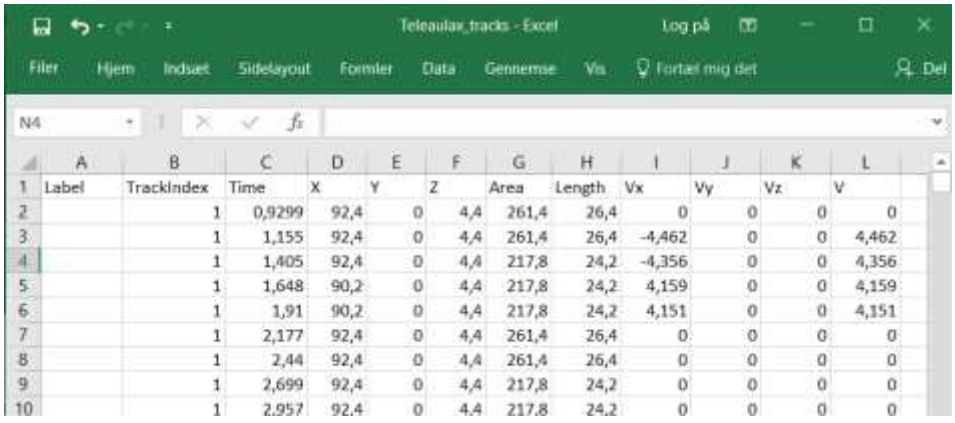
History = 10 Hiatory = 40 (default) History = 100

The “Frames per second” control changes the playback speed for file sources.

5. Save tracks

Save tracks in the Track settings dialog window, klick 

. Select a file location in the file path window that appears. Data are saved in .txt format, and can be opened in Excel. Video files will not be saved, when using this option.



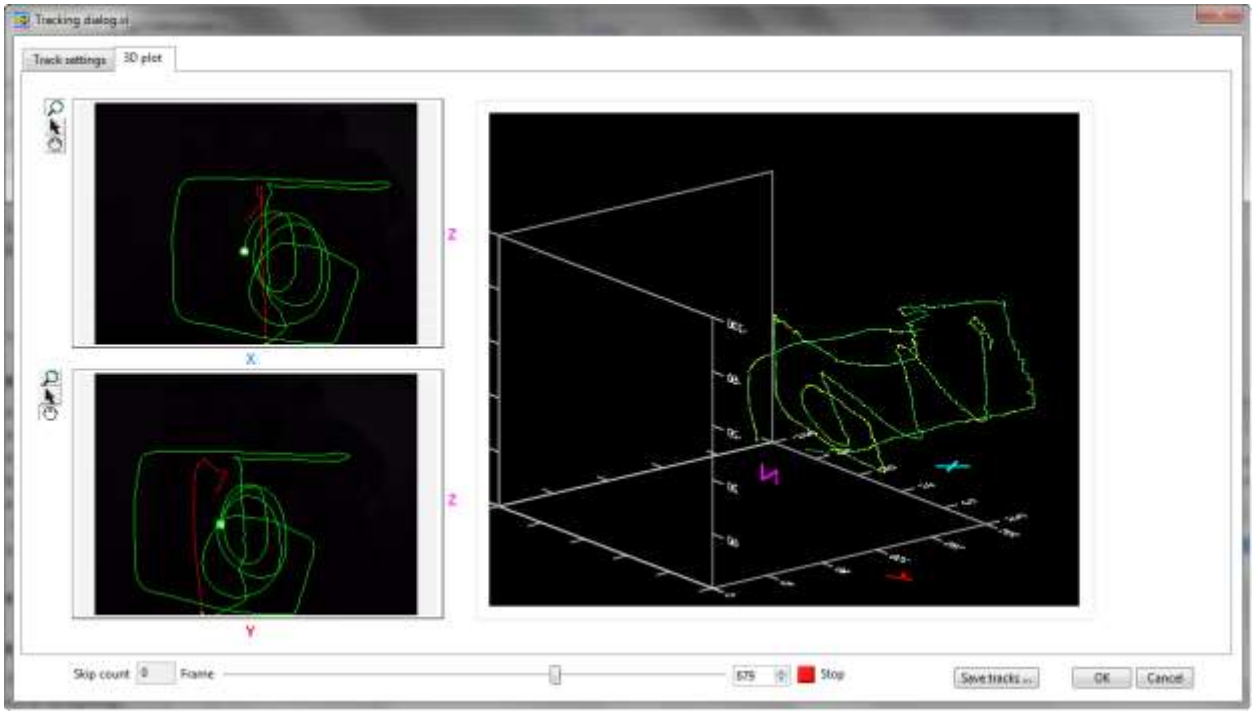
	A	B	C	D	E	F	G	H	I	J	K	L
1	Label	TrackIndex	Time	X	Y	Z	Area	Length	Vx	Vy	Vz	V
2		1	0,9299	92,4	0	4,4	261,4	26,4	0	0	0	0
3		1	1,155	92,4	0	4,4	261,4	26,4	-4,462	0	0	4,462
4		1	1,405	92,4	0	4,4	217,8	24,2	-4,356	0	0	4,356
5		1	1,648	90,2	0	4,4	217,8	24,2	4,159	0	0	4,159
6		1	1,91	90,2	0	4,4	217,8	24,2	4,151	0	0	4,151
7		1	2,177	92,4	0	4,4	261,4	26,4	0	0	0	0
8		1	2,44	92,4	0	4,4	261,4	26,4	0	0	0	0
9		1	2,699	92,4	0	4,4	217,8	24,2	0	0	0	0
10		1	2,957	92,4	0	4,4	217,8	24,2	0	0	0	0

Saved parameters:

Label	If tracks were labeled, the label is shown here
Track Index	Each track is individually numbered
Time	Time for each data point in seconds from session start
X	X coordinate
Y	Y coordinate

Z	Z coordinate
Area	Area of organism or particle (calibrated unit)
Length	Length of organism or particle (calibrated unit)
Vx	Velocity in the X direction
Vy	Velocity in the Y direction (3D plots)
Vz	Velocity in the Z direction
V	Velocity of the organism

3D tracking



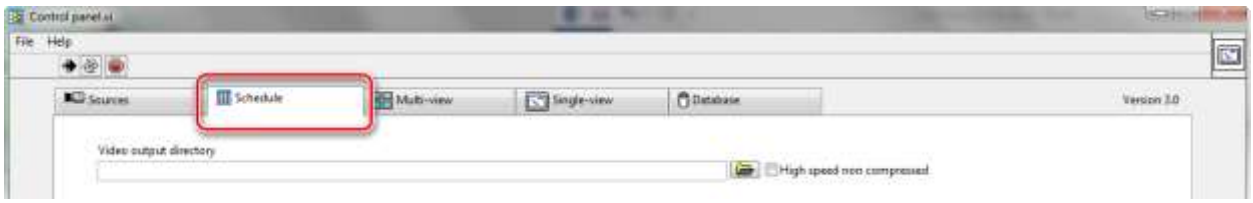
Matched tracks are given a unique color in the two source images. Tracks are plotted (with a certain delay) in the 3D graph. The graph can be rotated and zoomed.

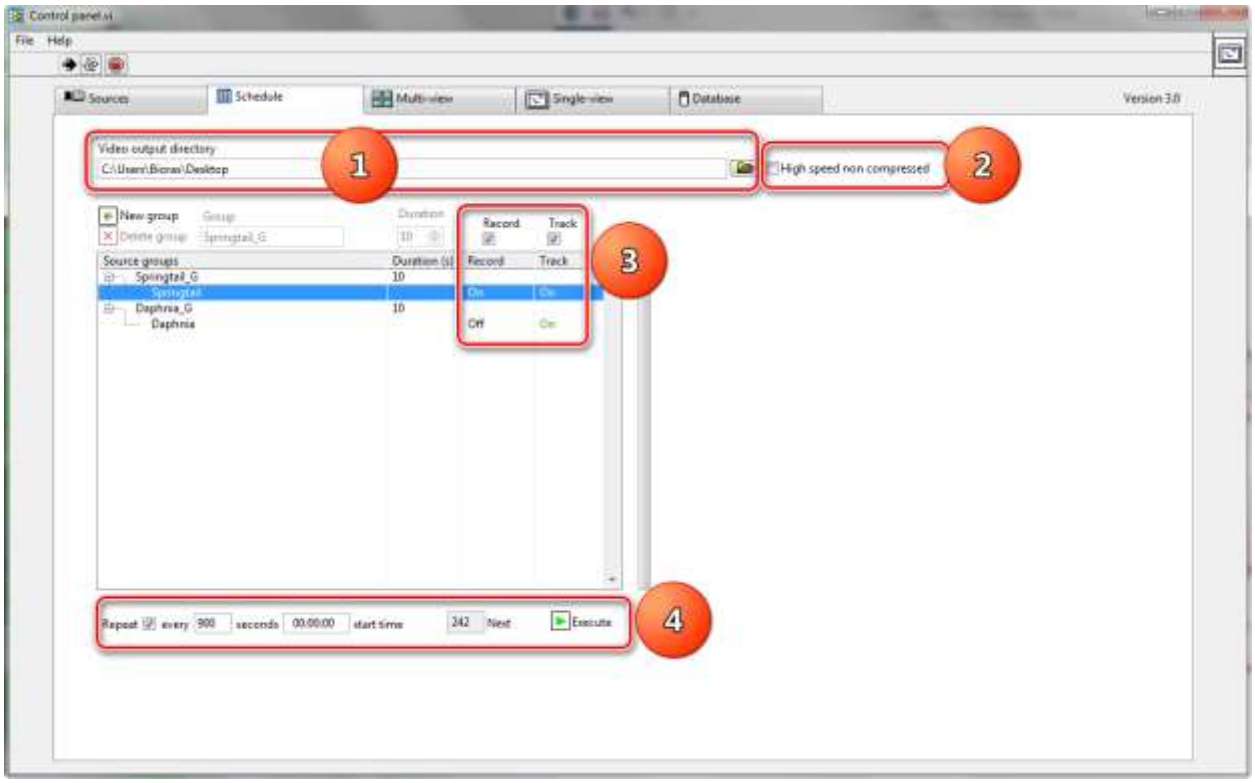
Saving track data

The current track data can be saved by clicking on the “Save tracks” button. Longer sequences that need to be streamed continuously can be set up in a schedule (see below).

Record videos and save track data using the Schedule function

Select the Schedule tab in the Control panel.





1. Video output directory

Select the directory where recorded video sequences will be saved, if required.

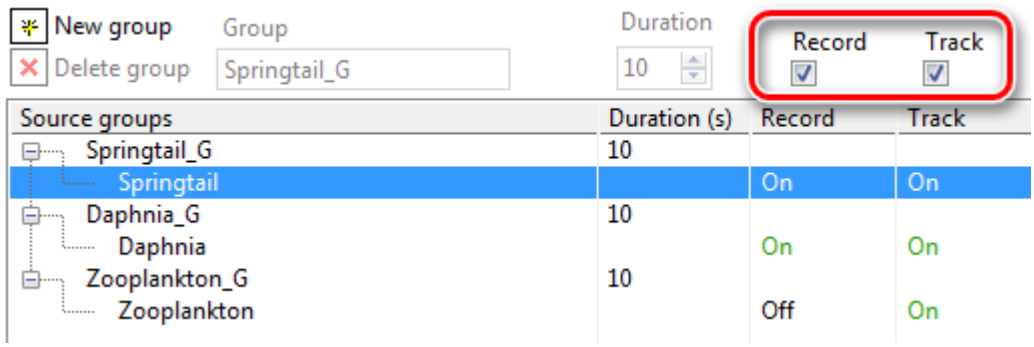
2. High speed non compressed option

☐ High speed non compressed

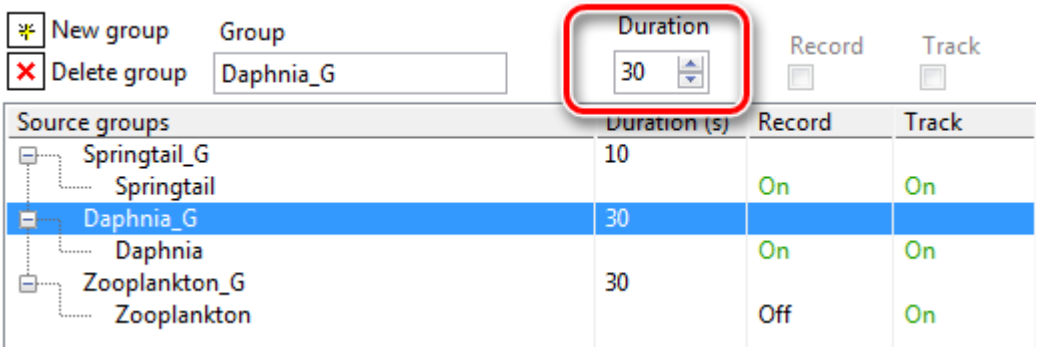
- The High speed non compressed option will save uncompressed video files. When streaming from an online source this options requires a disk that is fast enough to record in real time. The rate can be calculated by multiplying pixel size (1 byte for monochrome, 4 bytes for color) with horizontal resolution by vertical resolution by frame rate. A 1 megapixel image at 20 frames per second in monochrome would thus require a recording rate of 20 Mbytes per second, which is no problem for most disks but a 2 megapixel image at 50 frames per second in monochrome stereo would require a rate of 200 Mbytes per second which would require a good SSD disk or similar.
- If un-checked videos are compressed (default setting). The video file size is reduced by a factor 10 or so and some detail will be lost during recording.

3. Record, Track and set Duration of the track

Source groups are created for every Source in the Sources panel. All sources in a group are recorded and analyzed in parallel. Sources can be added to a group by dragging and dropping. Only group sources together if it required that they are analyzed in synchrony.

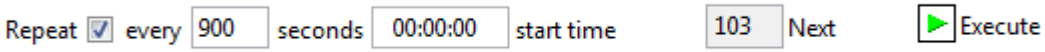


Each source can be set up individually. Record (to a video file) and Track (log track data) can be selected independently of each other by clicking on the source.



Click on the Group line, and set the record/tracking time for each group.

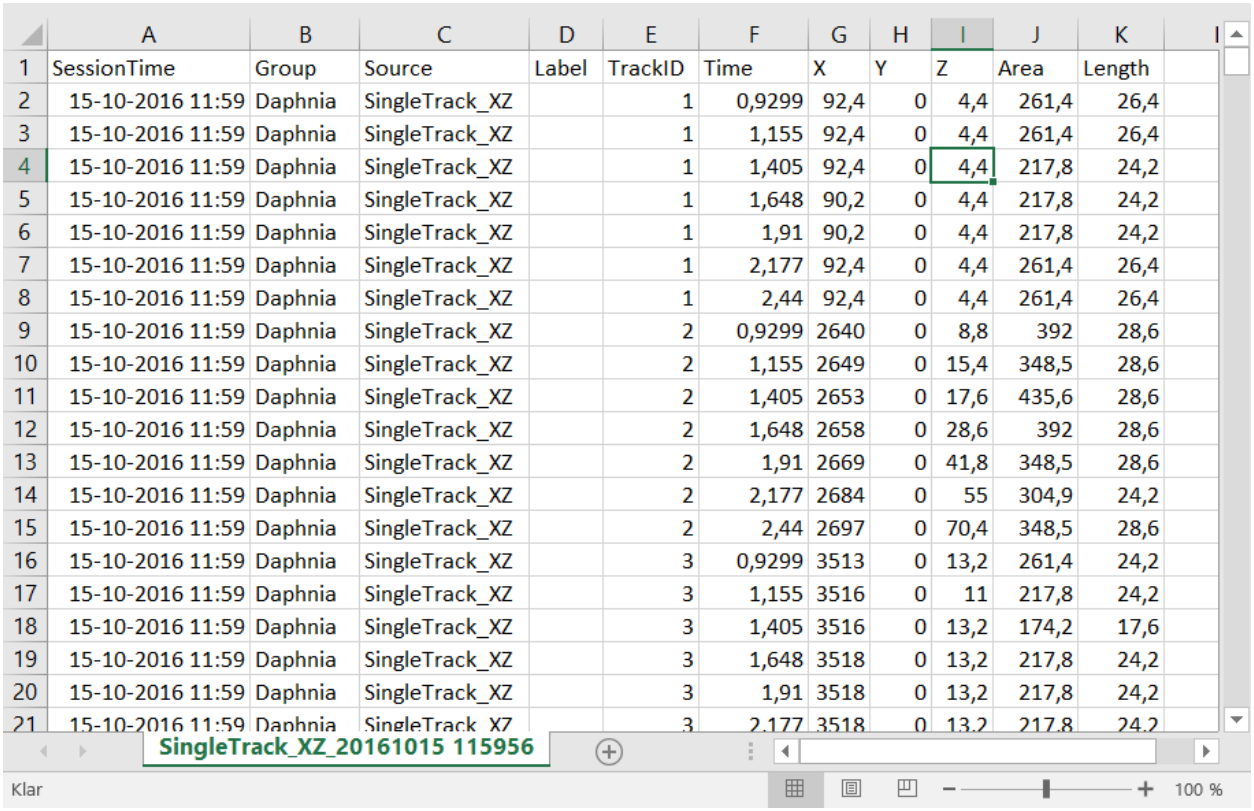
4. Start and schedule the recording and tracking



- Immediate recordings/analysis can be started by clicking the green Execute arrow.
- The schedule function can record videos and log track data at scheduled intervals. In the example above the scheduler has been set up to record/track a sequence every 15 min (900 sec.). The timer (start time) shows the recorded video length, and Next indicates the number of seconds until the next session starts. Groups are analyzed consecutively.
- Recorded video sequences are saved in the Output file directory (see above)
- Tracking data is saved in the following location on the computer: <Public documents>Bioras\Tracking\Import. They get moved to the Done directory if data is successfully imported into a database (see below)

Data log file format

Track data is saved in .txt format, and is ready for import into the database (see below), or it can be opened in Excel.



	A	B	C	D	E	F	G	H	I	J	K
1	SessionTime	Group	Source	Label	TrackID	Time	X	Y	Z	Area	Length
2	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	0,9299	92,4	0	4,4	261,4	26,4
3	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	1,155	92,4	0	4,4	261,4	26,4
4	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	1,405	92,4	0	4,4	217,8	24,2
5	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	1,648	90,2	0	4,4	217,8	24,2
6	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	1,91	90,2	0	4,4	217,8	24,2
7	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	2,177	92,4	0	4,4	261,4	26,4
8	15-10-2016 11:59	Daphnia	SingleTrack_XZ		1	2,44	92,4	0	4,4	261,4	26,4
9	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	0,9299	2640	0	8,8	392	28,6
10	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	1,155	2649	0	15,4	348,5	28,6
11	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	1,405	2653	0	17,6	435,6	28,6
12	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	1,648	2658	0	28,6	392	28,6
13	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	1,91	2669	0	41,8	348,5	28,6
14	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	2,177	2684	0	55	304,9	24,2
15	15-10-2016 11:59	Daphnia	SingleTrack_XZ		2	2,44	2697	0	70,4	348,5	28,6
16	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	0,9299	3513	0	13,2	261,4	24,2
17	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	1,155	3516	0	11	217,8	24,2
18	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	1,405	3516	0	13,2	174,2	17,6
19	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	1,648	3518	0	13,2	217,8	24,2
20	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	1,91	3518	0	13,2	217,8	24,2
21	15-10-2016 11:59	Daphnia	SingleTrack_XZ		3	2,177	3518	0	13,2	217,8	24,2

The following data is saved:

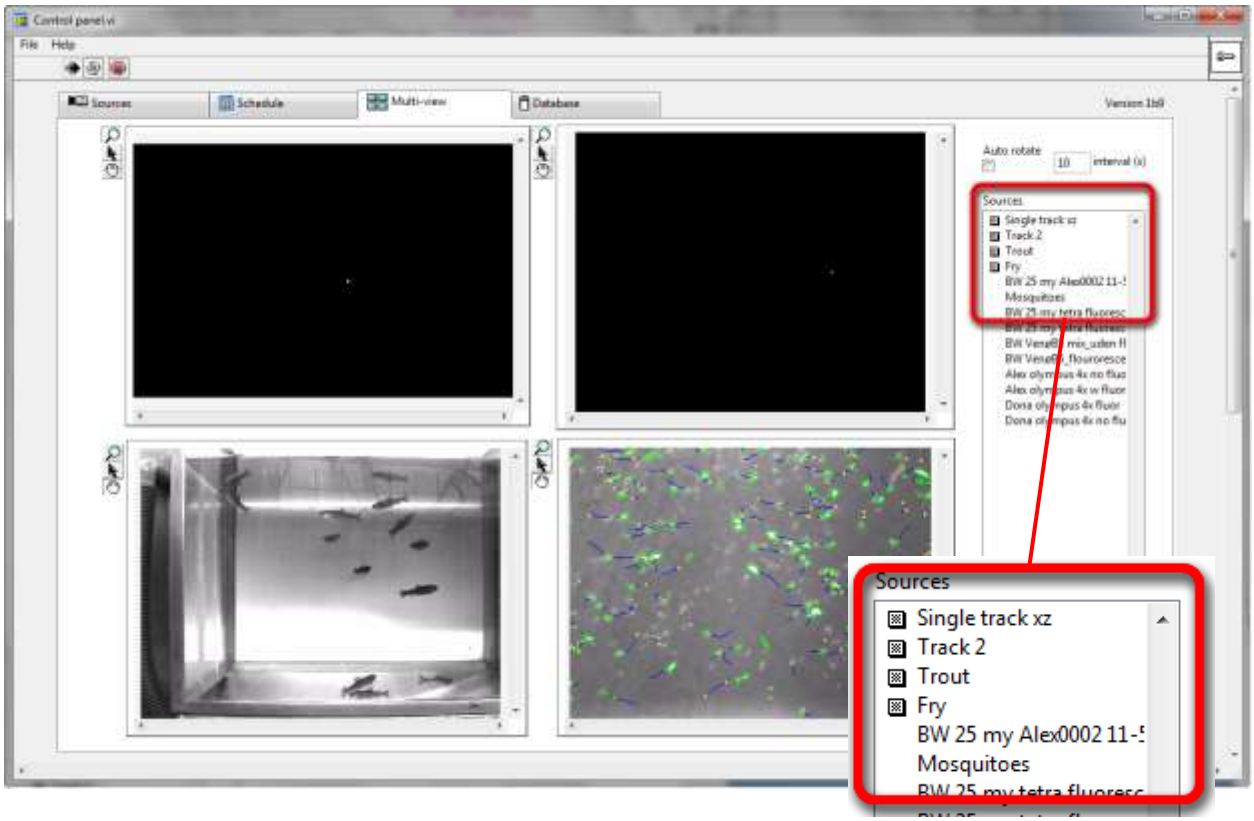
SessionTime	Date and time of the analysis
Group	Group name
Source	The given source name
Label	If tracks were labeled, the label is shown here
Track ID	Each track is individually numbered
Time	Time for each data point in seconds from session start
X	X coordinate
Y	Y coordinate
Z	Z coordinate
Area	Area of organism or particle (calibrated unit)
Length	Length of organism or particle (calibrated unit)

Multi View tab

Select the videos that should be displayed

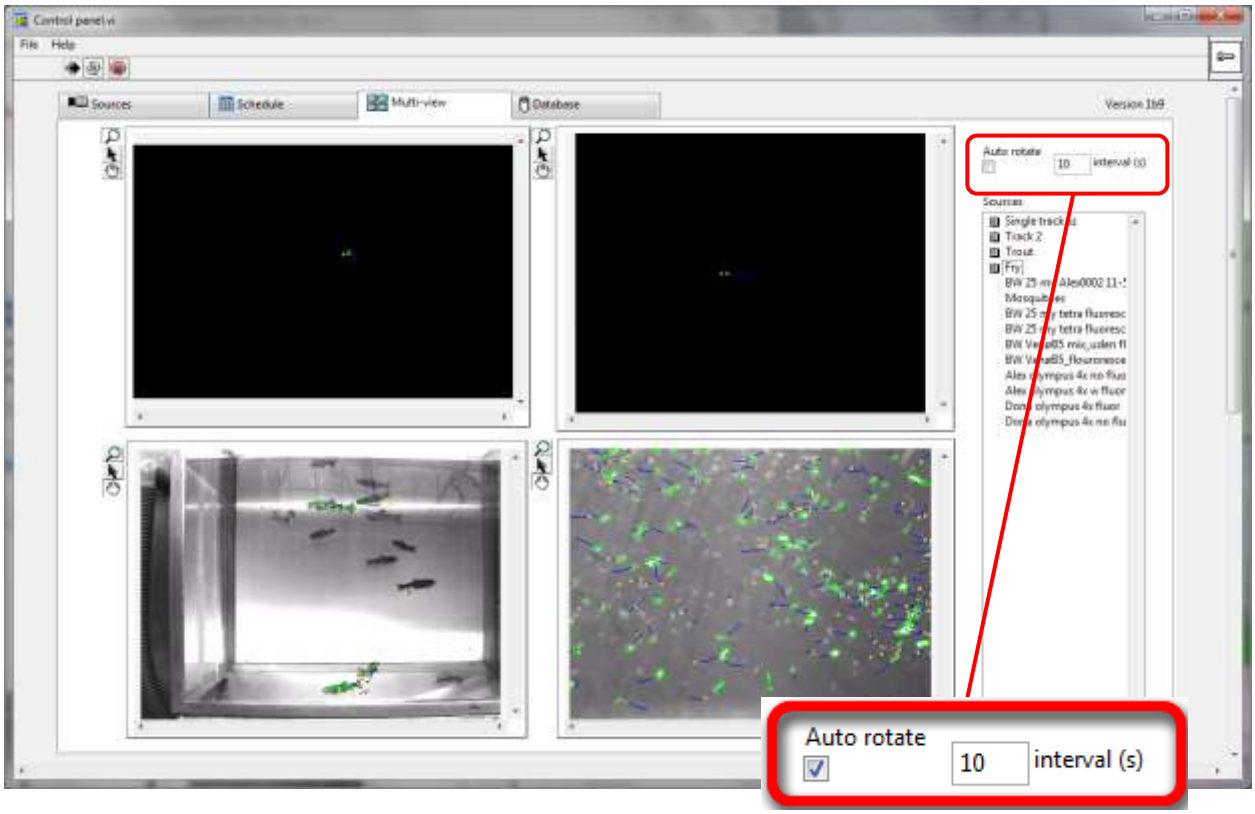
Up to 4 sources can be shown in the Multi view tab. This function gives a good overview for surveillance with multiple video cameras.

Select the videos that should be displayed by clicking on them in the Sources list.



Auto rotate between video

It is possible to auto rotate between available video sources by selecting Auto rotate, and specifying the rotation interval. The Auto rotate function will rotate between all available video sources.

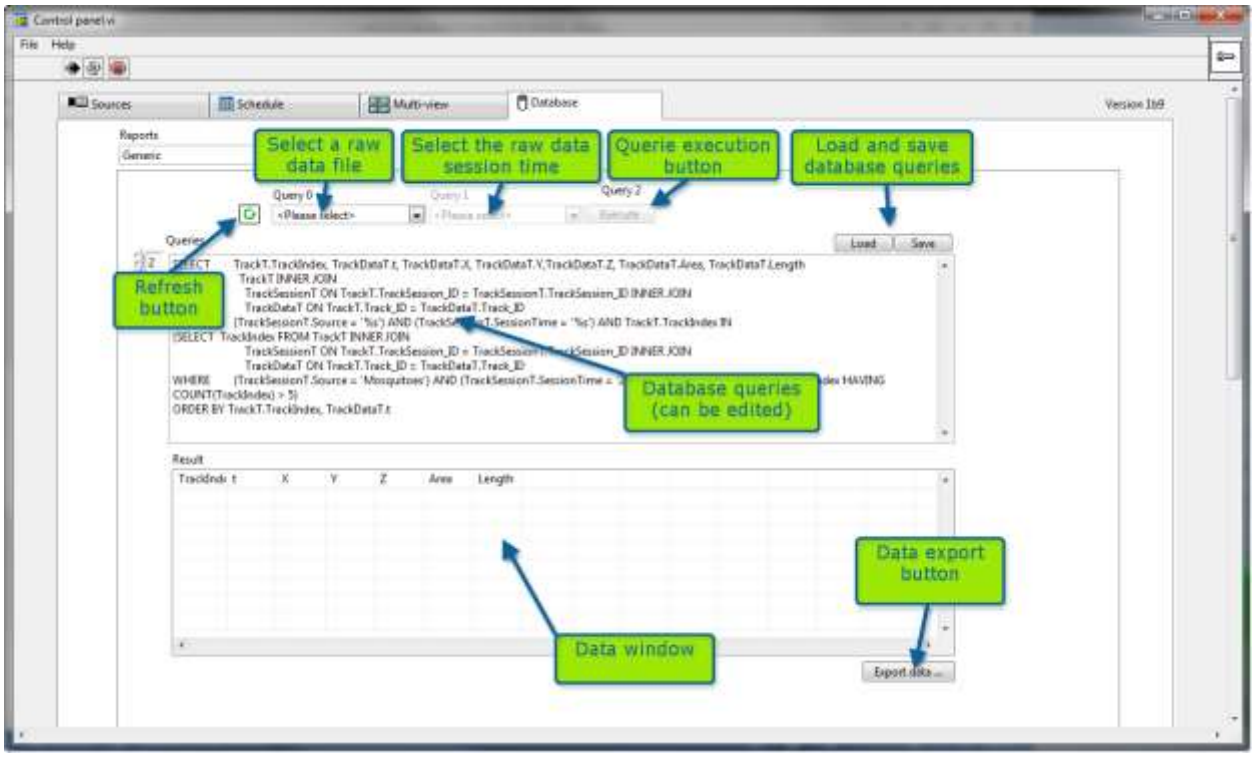

Auto rotate
10
interval (s)

Database Tab

A database is a powerful tool for management of track data.

LabTrack allows connection to an MS SQL database. MS SQL Express is freely available from: http://www.microsoft.com/en-us/server-cloud/products/sql-server-editions/sql-server-express.aspx#fbid=YpA6mdI1zIf

The Database tab consists of two panels: a Query panel and a Result panel, see below.

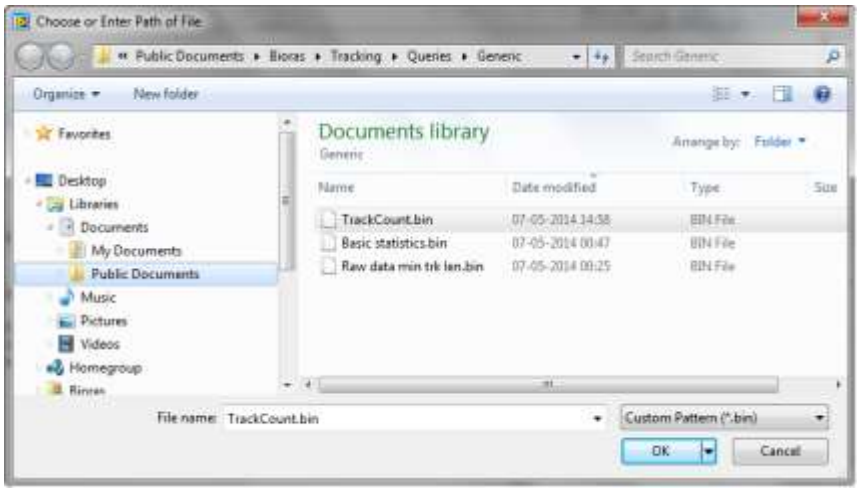


The database works with several layers of queries. Each level shows available data based on selection in the previous level. Query 0 selects a dataset, Query 1 selects a session, Query 3 executes the chosen database query.

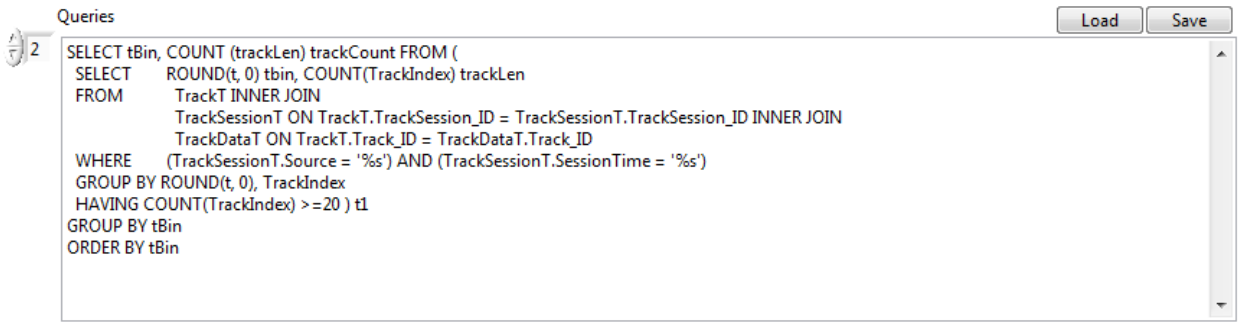
The database manages data, which have been logged during video analysis in the Schedule tab. The data log files are located in the Public Documents folder (C:\Users\Public documents\Bioras\Tracking\Import).

Select a Query

Start by selecting a Database Query. Queries are located in the Public Documents folder: C:\Users\Public\Documents\Bioras\Tracking\Queries\Generic

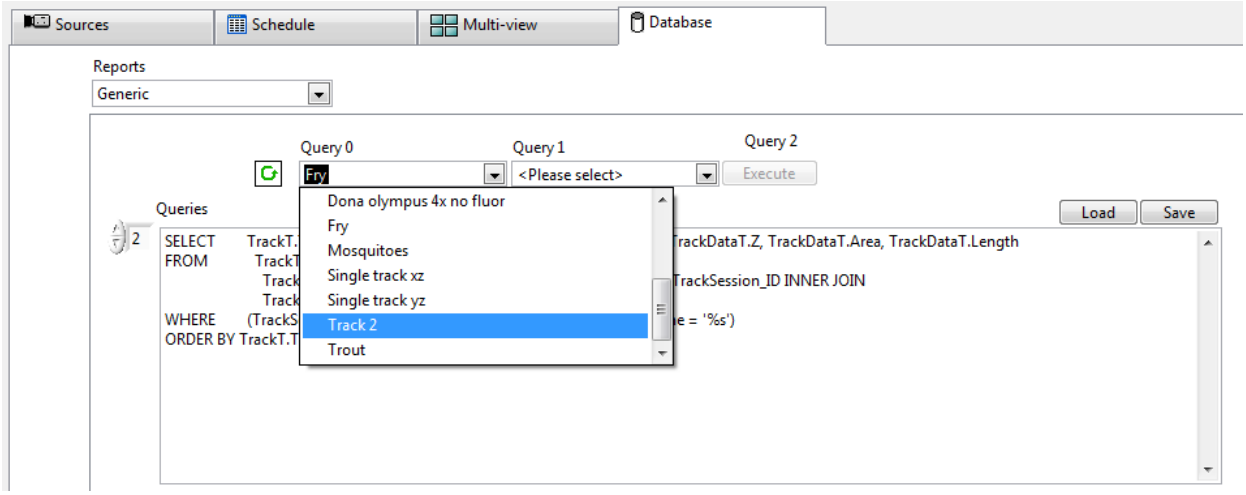


The Query will appear in the Query window:



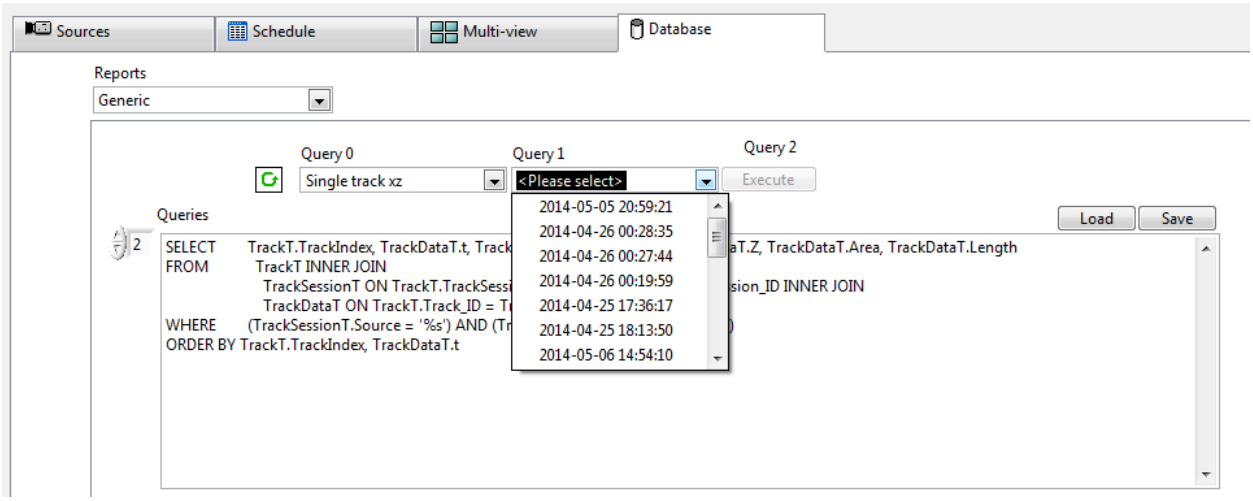
Select a dataset

Select a dataset from the Query 0 drop down menu.



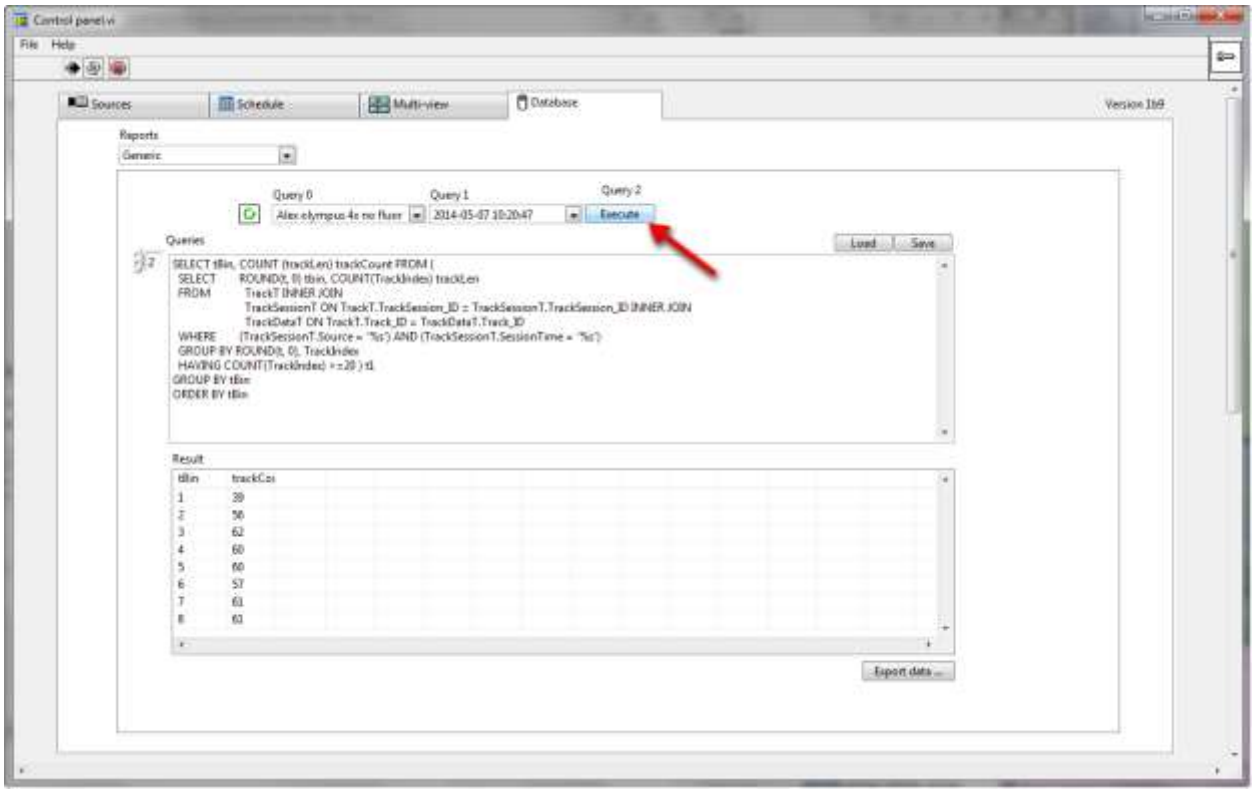
Select a Track session

If a schedule has been run several times for the same video source, the sessions will be saved as separate log files, with data and time stamps. Select a track session in the menu Query 1.



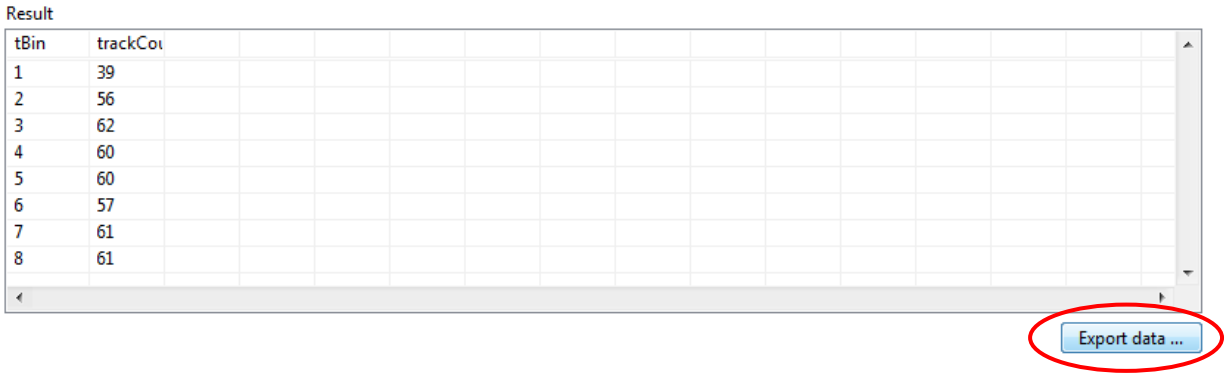
Execute a Query

Execute the query by clicking the Execute button. The data will be shown in the Result window.



Export the data

Click the Export data button, and select a location where the data should be stored on the computer (note that the data should not be stored in the LabTrack database folder under Public documents).



The data will be saved in .txt format, which can be opened in Excel or imported into a database.

Database columns

The database contains the following data columns:

Results | Messages

	TrackData_ID	Track_ID	X	Y	Z	t	Area	Length
1	1	1	16,5	0	17,9	0,03448	0,187	0,72
2	2	1	16,3	0	18	0,06897	0,292	1,08
3	3	1	16,2	0	18,1	0,1034	0,373	1,35
4	4	1	16	0	18,2	0,1379	0,462	1,62
5	5	1	15,6	0	18,7	0,1724	0,122	0,54
6	6	1	15,7	0	19,1	0,2069	0,13	0,54
7	7	1	15,9	0	19,4	0,2414	0,122	0,54
8	8	1	16,4	0	19,5	0,2759	0,0973	0,45
9	9	2	16,6	0	17,9	0,1724	0,122	0,54
10	10	2	16,6	0	17,9	0,2069	0,122	0,54
11	11	2	16,6	0	17,9	0,2414	0,122	0,54
12	12	2	16,6	0	17,9	0,2759	0,122	0,54
13	13	1	16,7	0	19,6	0,3103	0,162	0,54
14	14	1	17,3	0	19,8	0,3448	0,122	0,54

Database columns

TrackData_ID	Unique ID for each set of data in the databse
Track_ID	ID for each track within a dataset
X	X-position
Y	Y-position
Z	Z position (if applicable)
t	Time (sec.)
Area	Area of tracked organism or particle
Length	Length of tracked organism or particle

From these columns it is possible to calculate speed, position, track length, movement patterns, and countless other factors.