

Visualizing, recording and analyzing behavior

Viewer

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This system enables you to perform automatically controlled behavioral experiments without the disadvantages of an artificial setup such as skinner boxes or running wheels.

An animal in the setup is observed with a video camera mounted above the experimental arena, which is connected to a computer. VIEWER analyses the images in order to identify the animal within the arena, determine its position (head, body and tail) and represent different data.



Standard Features

Viewer

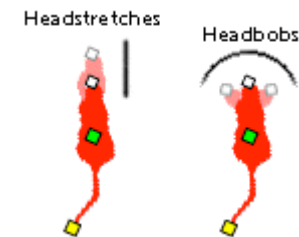
Object tracking with establishment of the subjects body axis

The object tracking software Viewer enables you to record and track an animal automatically in an experimental setup designed according to your individual requirements. The animals body is detected with a contrast filter method. The point of mass is determined, and if the animals body form is asymmetric, detection of the head and tail is possible enabling the establishment of the body axis **without marking the animal**.



Head bobs and head stretches

Due to the fact that we collect the x/y coordinates of **three points** (head, body and tail) our software can automatically detect and count behaviors like head bobs and head stretches in dependence on the settings you choose.

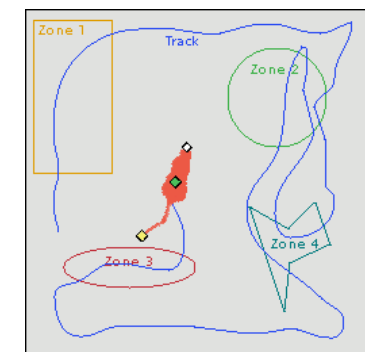


Zones

The zone definition function is very useful if you would like to observe, quantify, or compare the behavior of an animal in one or more defined areas of the experiment arena. You can create up to 50 zones with different forms or you can use a grid with columns and rows. Start/Stop zones

You can use the zones also for starting and/or finishing an experiment. Each zone can be defined as a Start/Stop zone.

Or you can use the zones to control external hardware when the animal steps into a zone by using the optional **output channels**.



Possible zone forms:
Rectangle, circle, ellipse, freehand
Possible number of zones:
50 zones



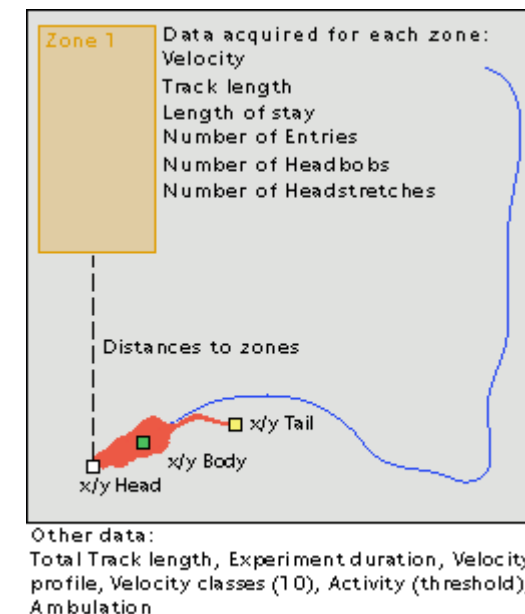
Data Acquisition

Based on the x/y coordinates, different parameters are calculated in real time during the experiment:

Time, track length, experiment duration, velocity, velocity classes (user definable), ambulation (user definable), activity/inactivity (user definable) and the distance of a reference point (head, body or tail) to each zone.

For each zone created, the following parameters are gathered:

Velocity, track length, length of stay, number of entries, number of head bobs, number of head stretches





Standard Features

Viewer

Intervention Potential

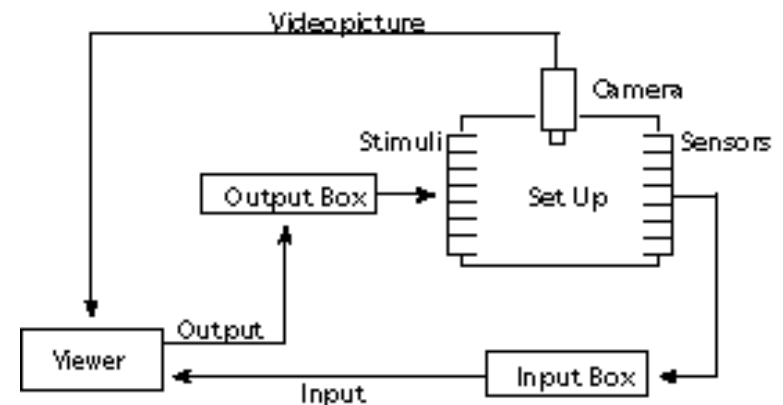
A variety of additional **input** and **output channels** are available for Viewer.

Besides the input channel for the video signal, Viewer's basic version contains an additional analogue input and output channel.

During object tracking you can record additional information (for ex. animal sounds) from the experimental arena through the additional input channel. The additional output channel allows you to intervene during the experiment. This can be conducted manually or via an automatically triggered program that can be either time or place dependent. The program can, for example, give out a signal (e.g. light flash) serving as a stimulus with rewarding or punishing character, either automatically as a function of time or as a recorded event. The event could, for example, be the touching of an object, the position of the observed animal in a defined area, or a behavioral pattern.

As an extension we offer external boxes, which can be controlled and exploited with the help of 8 analog input and 8 digital output channels.

With this possibility you can build fully automated training and learning experiments.





Standard Features

Viewer

Further processing of data and graphics

The data collected in the raw data table as well as in the result table can be imported for other applications. Further individual data manipulations can be conducted. The automatic export function for MS Excel or XML is integrated.

All diagrams and graphics that have been generated during the experiment are saved in the vector graphic format (wmf) thereby making them easy to integrate and work with in other programs. After having conducted an experiment, the movements of the animal can be redrawn as a trajectory in either defined time windows, or for the entire duration of the experiment.

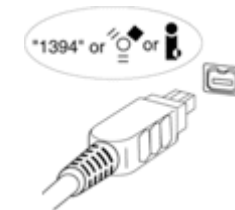
Export filters for the data: *.txt, *.doc, *.csv, *.xls, *.xml

Export filters for the graphs: *.bmp, *.wmf, *.emf

FireWire support

The software supports the FireWire/iLink port for digital video cameras. You can use any DV-Camera with a FireWire port. This simplifies the installation because no frame grabber card or driver problems occur. It's just plug and measure.

Of course you can use USB cameras, too.





Standard Features

Viewer

Digital video encoding included

You do not want to fill another locker with video tapes?

With the Viewer software you can directly encode your experiment to a digital video file in real time.

Easy to do, easy to store and easy to handle. These different source signals can be used with the Viewer software:

FireWire camera (live or tape), USB camera, analog camera, VCR, digital video file.



Recalculate old data with new parameters

Now you can easily recalculate old tracking data with new parameters.

Since the software stores all acquired data within the result file you can now reanalyze old data based on a new configuration.

Load a result file, change the configuration (e.g. modify the zones) and reanalyze the data. It takes only some seconds.

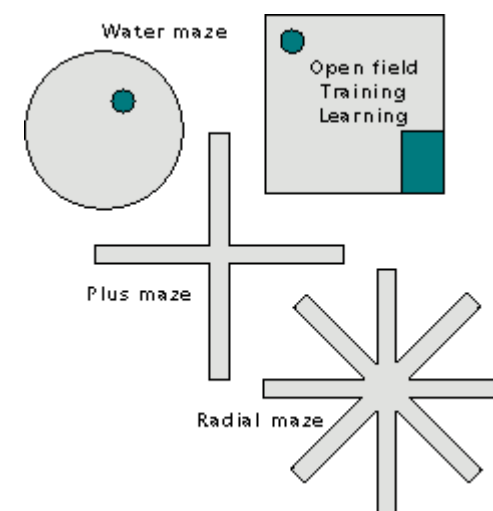
Thus you can also use your old data if a new question appears.



Flexibility

The Viewer software is a very extensive and powerful tool. The flexible character allows for practical operation in a lot of different experimental setups.

If you are wondering if the Viewer software can meet your individual experimental demands, please feel free to contact us. We will evaluate your requirements and adapt the Viewer's functionality accordingly.





The Plug-In solution

The Plug-In solution offers you flexibility and extensibility.

Viewer is a very flexible tool and offers a variety of parameters, graphs and data displays. However it cannot cover everything in the standard version and that's why we invented the Plug-Ins for our tracking software.

Either for standardized experiments (e.g. water maze) or for your special experimental set up we offer Plug-Ins that offers even more parameters in the configuration and different tables and graphs in the analysis.



Useful for many behavioral experiments

The "Viewer" tracking software can be used for many different experiments like all kinds of mazes, open field tracking, object recognition and novelty scan. It is a kind of a swiss army knife for behavioral phenotyping.





Program Tour - Configuration

Viewer

The configuration is divided into several areas:

Experiment | Camera | Filters and Objects | Zone Definition | Velocity Class Definition | Behaviour | Saving options

Experimentator:	<input type="text" value="Bob Berg"/>
Experiment No.:	<input type="text" value="164-4"/>
Short description:	<input type="text" value="Control"/>
Long description:	<input type="text" value="New environment"/>
Animal name:	<input type="text"/>
Animal No.:	<input type="text" value="12/56-9"/>
Date/Time:	<input type="text" value="23.09.2002"/> <input type="text" value="00:16:49"/>
<hr/>	
Time controlled execution:	<input type="checkbox"/> start experiment at <input type="text" value="23.09.2002"/> <input type="text" value="00:16:49"/>
	<input type="checkbox"/> stop experiment after <input type="text" value="01:00"/> <input type="text" value="00"/> hours:minutes

Experiment

In "Experiment" you can save a description of the experiment and adjust the settings to start and stop the experiment automatically.



Program Tour - Configuration

Viewer

Video settings

Video devices: VEN_85 MOD_0 CAMCORDER DV

Input source

☐ Analog ☒ Digital

Analog settings

Frame rate: 15

Video size:

Digital settings

DV capture size

Default ☒

Dc

Quarter

Half

Full

Filters and Objects

Allows you to adjust the filters for the animal recognition.

Camera

The "Camera" section enables you to configure the camera that is used for the experiments.

Live picture

Switch On Switch Off

Tracking mode

☒ Dark animal/bright background

☐ Bright animal/dark background

Tracking area

Fullscreen Rectangle

Free formed Ellipse

Background filter

20

Accept Reset

Animal filter

min. animal size: 600 Pixels

90



Program Tour - Configuration

Viewer

Setup calibration 10 Pixel = 0.81 cm

☒ Use grid

Grid options:

Number of rows: 1 each 20.0 cm

Number of columns: 1 each 20.7 cm

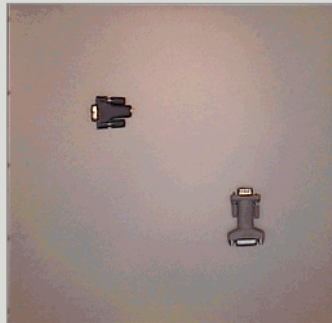
☐ Use self defined zones

Self defined zones:

Modify Rectangle

Delete Free formed Ellipse

No.	Form	Size	Trigger	Channel



Zone Definition

You can define different zones within the arena which will be evaluated separately in the subsequent data acquisition. The zones can also be used as start and stop zones or to trigger external hardware.

Velocity Class Definition

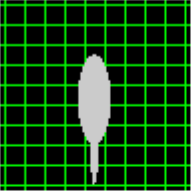
You can determine up to ten different velocity classes in order to subdivide velocity profile of the animal.

Class	From	To
1	0.0 cm/s	5.0 cm/s
2	5.0 cm/s	10.0 cm/s
3	10.0 cm/s	15.0 cm/s
4	15.0 cm/s	20.0 cm/s
5	20.0 cm/s	25.0 cm/s
6	25.0 cm/s	27
7	30.0 cm/s	30.0 cm/s
8	30.0 cm/s	30.0 cm/s
9	30.0 cm/s	30.0 cm/s
10	30.0 cm/s	30.0 cm/s

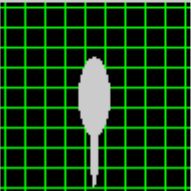


Program Tour - Configuration

Viewer

Headbobs:  Animal velocity limit: 0.8 cm/s

Head movement threshold: 158 °/s

Headstretches:  Animal velocity limit: 0.8 cm/s

Head stretch threshold: 1.85 cm/s

Behavior

You can set different filters for the automatic detection of ambulation, headbobs and headstretches.

Saving options

Different options for saving the data.

☒ Saving Raw data

Summary

Summary Interval every minutes

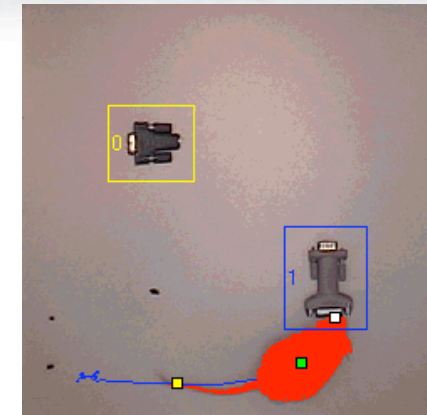
☒ Saving animal track



Program Tour - Acquisition

Viewer

During the tracking process the three points are tracked and object recognition is counted each time the nose of the animal enters one of the two zones shown here.

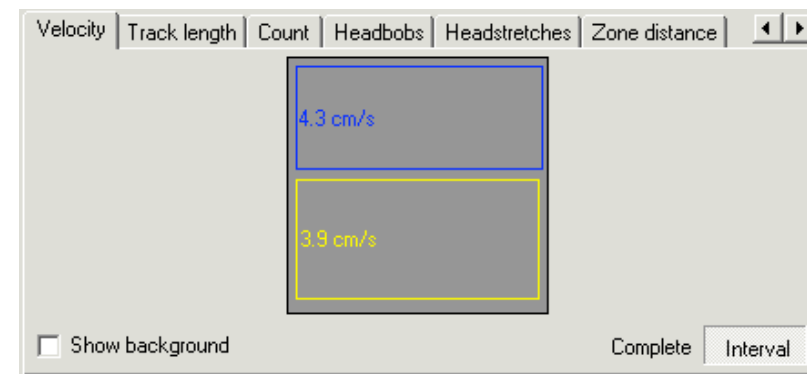


Raw data:

Date	Time	Head	Body	Tail	Velocity
07.05.2003	11:58:11	(184,88)	(211,58)	(259,58)	3.5 cm/s
07.05.2003	11:58:11	(184,90)	(212,58)	(265,88)	2.0 cm/s
07.05.2003	11:58:11	(185,91)	(212,58)	(264,81)	1.4 cm/s
07.05.2003	11:58:12	(170,81)	(210,59)	(264,77)	1.0 cm/s
07.05.2003	11:58:12	(173,83)	(209,59)	(264,77)	0.5 cm/s
07.05.2003	11:58:10	(187,76)	(221,52)	(259,74)	3.5 cm/s
07.05.2003	11:58:11	(182,79)	(216,57)	(258,66)	4.1 cm/s

Various parameters are analyzed and calculated. You have the possibility to choose a still image of the experimental setup as background image. The data are presented for each interval (user definable) or for the complete experiment.

This picture shows acquired raw data. All data are saved and can be exported in various file formats.



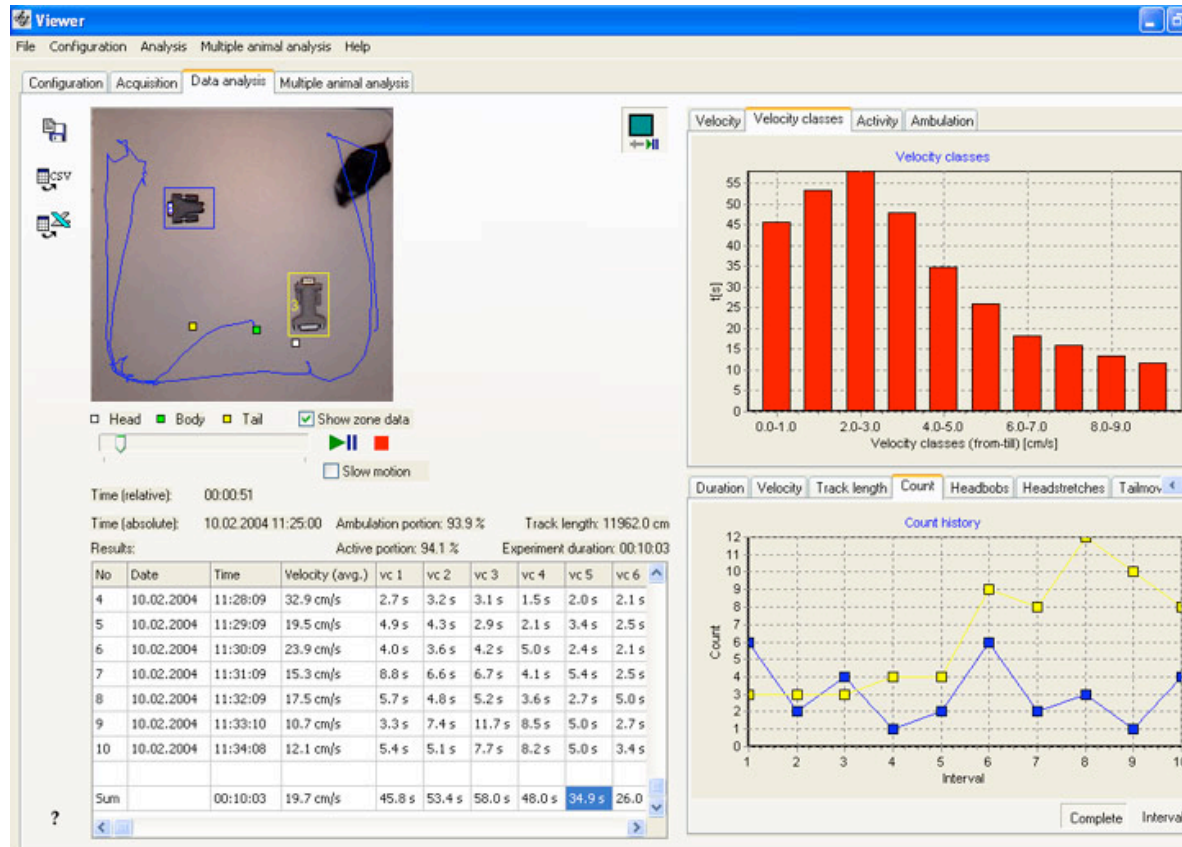


Program Tour - Analysis

Viewer

All data that have already been calculated and analyzed during the experiment are again available in the Data Analysis section of the program.

Furthermore you can watch a repetition of the experiment (even in slow motion) with the tracked trajectory of the animal. The background of the trajectory is again a still image of the setup.



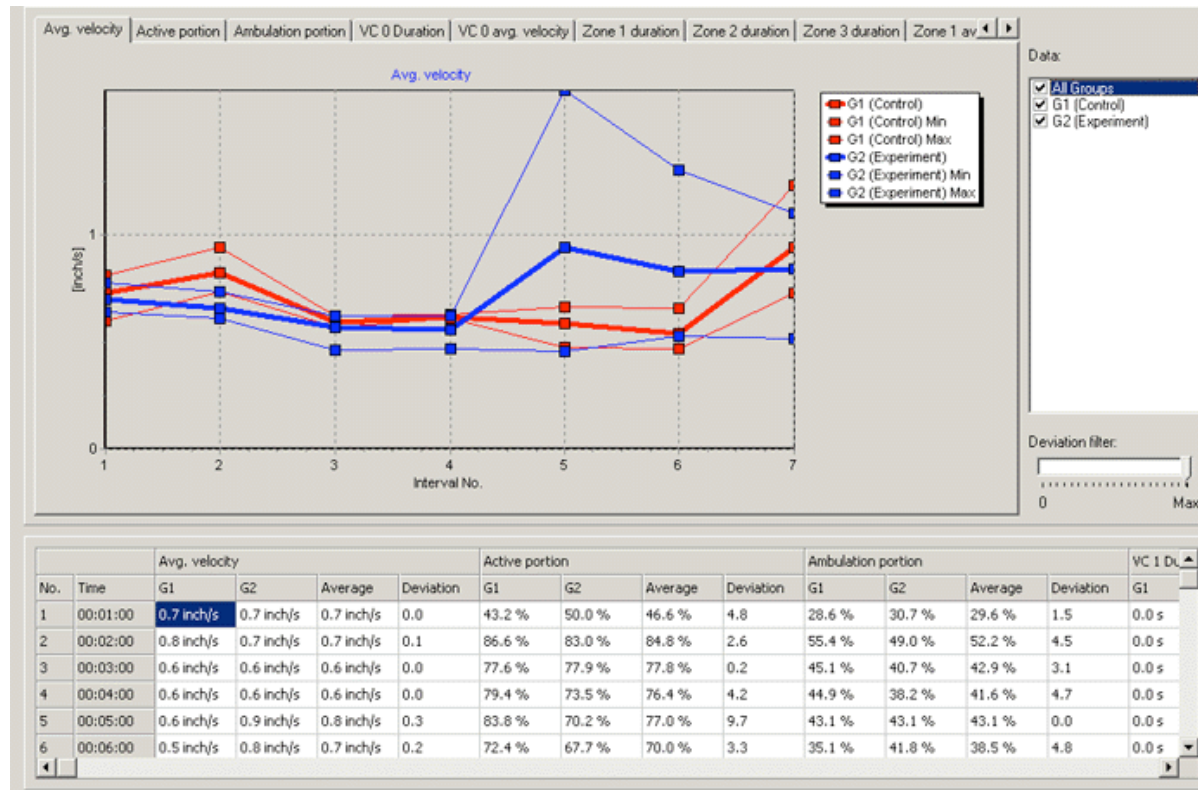
All data and figures can be exported in various formats.



Program Tour – Multiple Experiment Analysis

The Multiple Experiment Analysis (MEA) enables you to compare and recalculate data from different experiments.

The following figure is an example for the great possibilities and flexibility that this software module provides to you.



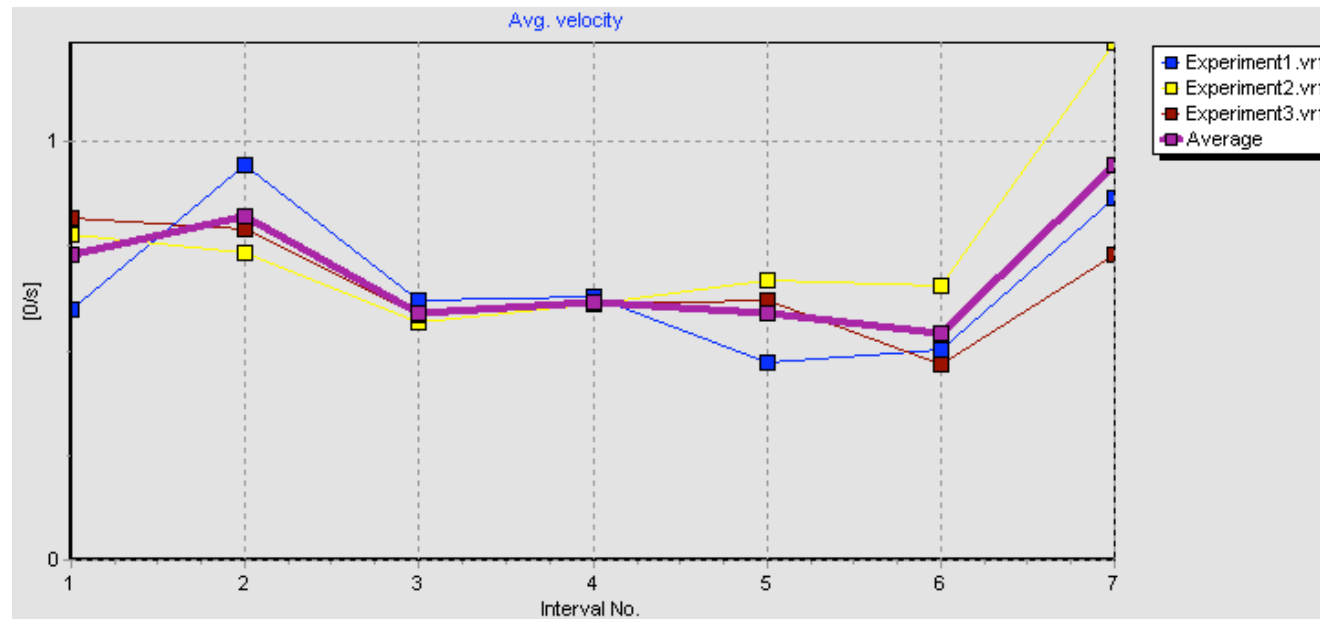
You can build different groups, where you can pool experimental data and the software calculates mean values etc. for each group.

You can compare the experiments within one group and you can analyse the differences between the groups.



Program Tour – Multiple Experiment Analysis

The next figure shows for example the average velocity (blue, yellow and red) of the animal in three different experiments over certain time intervals. The bold purple line is the average velocity of all three experiments.



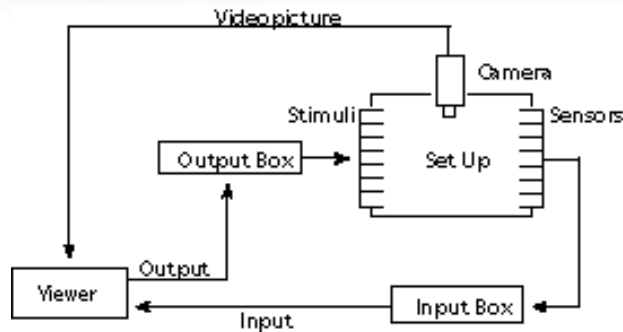
If you now want to know, how the average looks like if you exclude one of the three experiments from the average calculation, simply choose the line you want (the yellow one in this example) and choose "hide" from the context menu. The line turns grey and the data of this experiment won't be included in the average calculation any more. As a result, the purple average line will be redrawn.

This can be done with all data the software acquires during the tracking! Think about the possibilities that this feature provides. Rearrange your data and see the result in a graph instantly! Of course you can save and print the figures in various formats (*.bmp and vector based as *.wmf) for further use.



Program Tour - Interaction

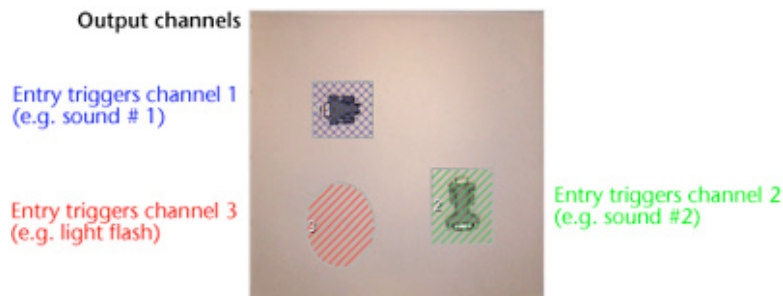
Viewer



Our tracking system can be used to automate training and learning experiments. The input and output channels offer the possibility to control experiments automatically. No human observer is needed any more to perform more complex behavioral experiments.

Input channel

Besides the input channel for the video signal, Viewer's basic version contains an additional analog input and output channel. During object tracking you can record additional information (for ex. sound) from the experimental arena via the input channel.



Up to 8 channels: As an extension we offer external boxes, which can be controlled and exploited with the help of 8 analog input and 8 digital output channels.

With this possibility you can build fully automated training and learning experiments.



Output channel

The additional output channel allows you to intervene during the experiment. This can be conducted manually or via an automatically triggered program that can be either time or place dependent. The program can, for example, give out a signal (e.g. light flash) serving as a stimulus with rewarding or punishing character, either automatically as a function of time or as a recorded event. The event could, for example, be the touching of an object, the position of the observed animal in a defined area, or a behavioral pattern.



Plug-Ins

Viewer



The Plug-In solution offers you flexibility and extensibility.

As you have seen in the Features and Program tour section, Viewer is a very flexible tool and offers a variety of parameters, graphs and data displays. However it cannot cover everything in the standard version and that's why we invented the Plug-Ins for our tracking software.

Either for standardized experiments (e.g. water maze) or for your special experimental set up we offer Plug-Ins that offers even more parameters in the configuration and different tables and graphs in the analysis.



Plug-Ins

Water Maze plug-in

Following parameters are measured:

- Latency
- Swim path length
- Swim speed
- % of time in each quadrant
- Platform crossing
- Heading angle error
- Average distance from platform
- Latency to first crossing
- Direct swim (yes/no)

Viewer

Configuration Acquisition Data analysis Multiple animal analysis **Module analysing**

Active dataset: 0 Experiments: 4 Filename: demo_waterrnaze.vmf

Experiment list


Date	Time	Use	Swimspeed	Swimlength	DirectSwim	H. Error	T. Z. Crossing	A. distance	Latency
29.03.200	15:03:51	X	5,17	156,71	No	101,91	0	15,02	25,63
29.03.200	15:04:45	X	4,91	150,22	No	89,94	0	15,28	26
29.03.200	15:05:30	X	5,22	154,58	No	96,19	0	14,97	24,76
29.03.200	15:06:35	X	5,25	156,84	No	96,53	0	15,39	25,5

Buttons: New file..., Open file..., Save file, Delete dataset, Copy result, Print result..., Print report...

Statistic

	Swimspeed	Swimlength	DirectSwim	H. Error	T. Z. Crossing	A. distance	Latency
Average	5,14	154,59	0	96,14	0	15,16	25,47
STD	0,13	2,68	-	4,24	0	0,18	0,45

Buttons: Save statistic..., Copy statistic, Repaint



- ☒ show setup
- ☐ show zones
- ☐ show platform
- ☐ show track
- ☐ show heading error
- ☐ show direct swim channel

☐ Black ☒ White

The distance for the heading angle error calculation and the width of the direct swim corridor can be defined in the program.

The analysis shows (additionally to the standard analysis) a table with all relevant water maze parameters and a visualization of the experiment with the swim path, zones, heading angle error and the direct swim corridor.

In addition to the standard result file for each trial you can pool multiple trials (mostly 16) in a separate result file where the average values for each parameter are calculated automatically.



The Viewer tracking system can be used to perform a wide range of behavioral experiments, starting with simple **maze** or **open field** experiments, followed by **social interaction** experiments with more than one animal. A very special and challenging experiment are **object recognition** or **novelty scan** experiments. Even these tasks can be automated with our system very comfortable.

The following description shows you how easy an object recognition experiment is set up and how the acquired data are presented in the software.

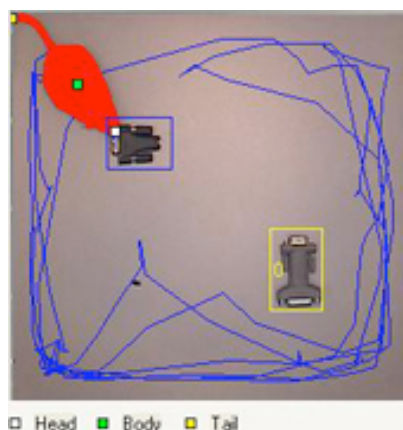
To perform an object recognition experiment with a tracking software, it is necessary that the software is capable to detect not only the center of mass of the animal but also the nose and the tail. Otherwise it is not possible to ensure that the animal has inspected the object with its nose. The “Viewer” tracking software tracks all three points of an animal (nose, center of mass, tail).

To perform an object recognition experiment, two ore more objects are placed within an arena. Around each object a zone is drawn in the software. Each time the animal enters a zone with its nose is counted.



Setup:

Two objects are placed in an arena. Around each object a zone is drawn in the software (blue and yellow). The program measures, how often the nose of the animal enters a zone to inspect an object.



Experiment:

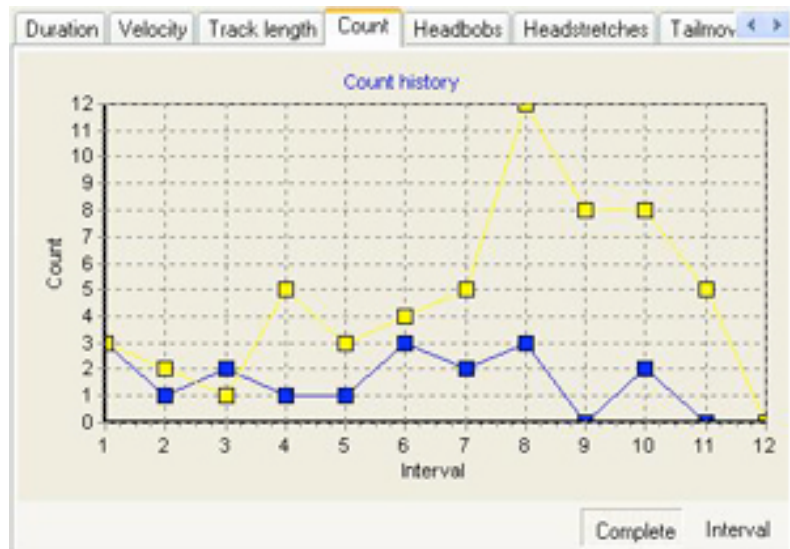
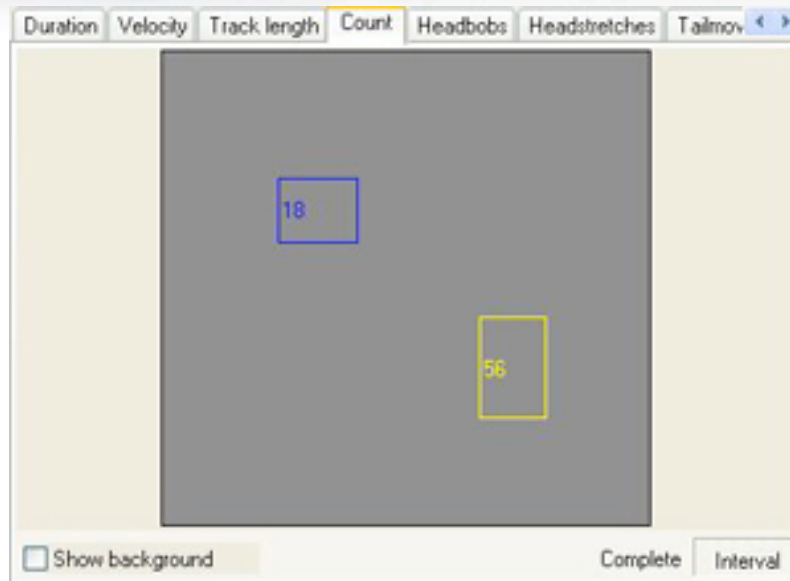
The animal inspects the object in the blue zone. The blue line represents the trajectory of the animal. The numbers in the zones show how often the animal entered a zone within the current interval (definable, in this experiment one minute).

Our software not only tracks the point of mass of the animal but also the nose and the tail. The colored squares represent these points (white: nose; green: center of mass; yellow: tail).



Experiments

Viewer



Results:

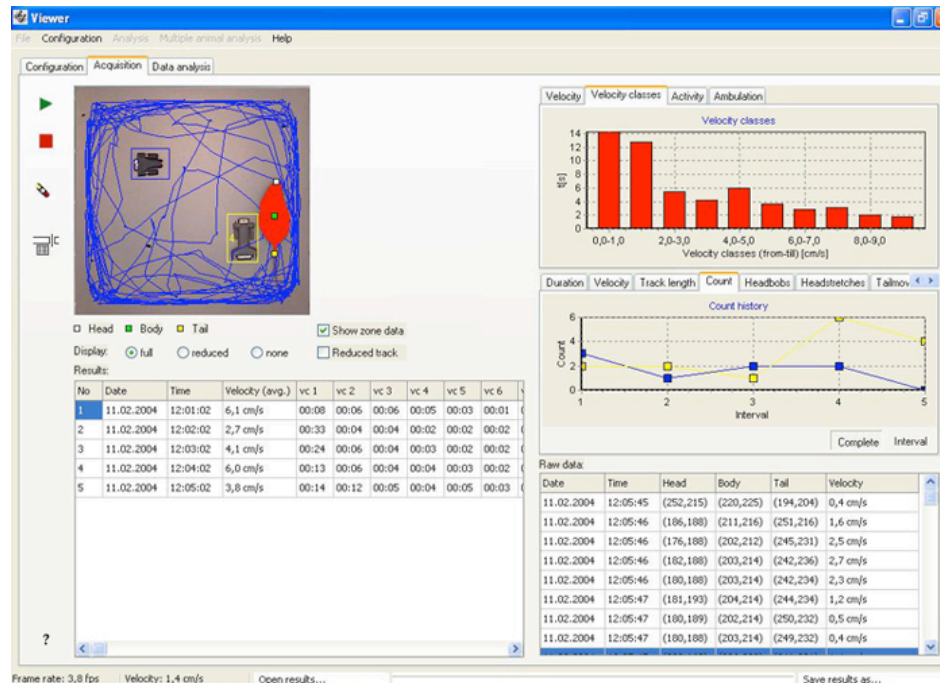
This figure shows how often the animal entered each zone during the whole experiment (12 minutes). The blue zone 18 times and the yellow zone 56 times.

This figure shows how often the animal entered each zone during each time interval. It is very nice to see how the animal inspects both objects with quite the same interest during the first three minutes and is much more interested in the object in the yellow zone after that. The time interval can be defined by the user (in this experiment one minute).



Experiments

Viewer



Screenshot of the software during an experiment. In the left upper corner the video picture with the tracked animal is shown. Below the video picture the table with the summarized data is presented. On the right side are two areas where the data are presented graphically. With the tabs you can switch between the different figures. In the lower right corner you can find the table with the raw data.

General information:

Beside the special parameters for the object recognition experiments, the software can of course be used for all of the standard maze and open field experiment as well. It measures a lot of parameters like:

- experiment duration
- track length
- velocity
- activity (definable threshold)
- ambulation
- distance to zones
- zone entries
- time in zone
- track length in zone
- headbobs
- headstretches

The data are calculated and presented in real time during the experiment. All data can be exported in various file formats (*.txt, *.doc, *.csv, *.xls, *.xml) and all figures can be exported as well (*.bmp, *.wmf, *.emf).



Add-on products

Viewer



Custom made infrared illumination devices improve the results of the video analysis.



Digital video cameras (FireWire/iLink) are used to feed the video signal into the computer with the FST Analysis software.



An A/D video converter can be used to feed analog video material (either live or taped) into the system.



We offer custom made mazes, arenas and experimental setups.



As an extension we offer external boxes, which can be controlled and exploited with the help of 8 analogue input and 8 digital output channels. Thus you can build fully automated training and learning experiments.



A remote control to start and stop the program without the keyboard can be useful in behavioral experiments.



We offer "out-of-the-box" systems that include all devices (computer, camera, cables, illumination etc.) that are necessary to set up a tracking system.



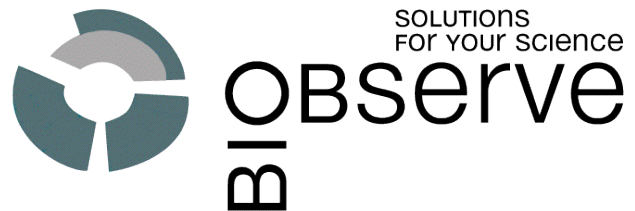
Thank you!

Viewer

Thank you very much for your interest in our solution.

We hope we could provide you an useful overview over the features and capabilities of our Solution for visualizing, recording and analyzing simple and complex behavior – „Viewer“.

If you have further questions, please do not hesitate to contact us.



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