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Panlab

An Affiliate of Harvard Bioscience, Inc.

USER MANUAL

SMART 3.0.07

MAN-SOFT SMART Rev 02

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1. Introduction

SMART is a complete and user-friendly video-tracking system for evaluating behaviors in experimental animals. It allows the recording of trajectories, activity, specific behavior (such as rotation, stretching and rearing) and events and performs the calculations of a wide range of analysis parameters.

Social behavior interactions, stimuli generation and task automation are also available on demand. Please contact your dealer to get more information on these amazing capabilities.

The system offers a flexible and easy to learn interface for setting up a wide variety of behavioral tests: Water Maze, Open Field, Plus/Radial Arm/T-Y Mazes, Place Preference, Forced Swimming and Tail Suspension tests in addition to other user-designed applications.

SMART provides data relevant to problems in basic and clinical psychopharmacology. Applications include phenotype characterization (differences between strains, effect of a genetic modification, etc.) and studying the behavioral effects of pharmacologic substances.

Classic experiments on rodents performed using SMART include:

1) Motor and locomotive activity.

2) Anxiety (open-field, plus maze, O-maze, black and white box).

3) Learning and Memory (water-maze, radial maze, T-Y maze).

4) Addiction/Reward (conditioned place preference).

5) Depression (forced swimming and tail suspension tests).

6) Social behavior.

7) And many other possibilities.

SMART provides exceptional and reliable tracking under extreme conditions (low-lighting, great similarity between the subjects and the scenario, etc.). A powerful and robust video-detection core, based on digital video technology, and a user-friendly interface makes it easy to configure all the required parameters.

A Test window allows the user to see in real time how parameters affect video detection before starting the data acquisition trials. Besides, luminosity, brightness and contrast controls are available.

SMART can process images from almost any source: analogic videotapes (PAL or NTSC), DVD/HD recorders, films stored into digital video files (AVI, DIVX, MPEG, etc.) and digital image devices such as webcams, DV cameras and WIA-compatible imaging devices in general.

SMART outstanding analysis tools generate a wide variety of reports and statistics, which can be configured at will and applied simultaneously within a batch of hundreds of trials.

Results can be exported to the most used spreadsheet and statistics software packages in the market. The acquired data can be checked and analyzed either in the lab (where the images are obtained in real time) or on any other computer (including laptops). SMART can be installed in as many computers as required, so that the user can review data, generate statistics, print out results.

With **Panlab In-Touch!**, customers can also reach Panlab to get tech support, give their opinion about the software, new products or features or just let Panlab know any idea to improve the experience.

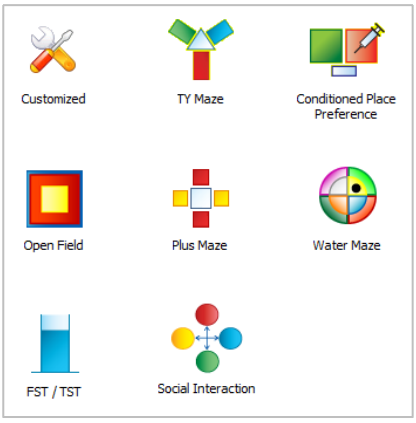
1.1. Simply SMART. Simply powerful.

SMART personality is characterized by two great attributes: simplicity and power.

Modules and *extensions* represent these attributes by enabling SMART to fit perfectly into the needs of your experimental projects and, at the same time, by proving powerful, efficient and flexible tools to discover key relationships during your observations.

Modules provide specific tools to cover the demands of the experimental paradigm (test) applied such as predefined zone templates, stop conditions and advanced analysis reports and calculations. The supported modules are:

- SMART-CS: Customized (user-defined) test.
- SMART-TY: T/Y-Maze test.
- SMART-CPP: Conditioned Place Preference test.
- SMART-OF: Open Field test.
- SMART-PM: Plus Maze test.
- SMART-WM: Morris Water Maze test.
- SMART-FST: Forced Swimming / Tail Suspension test.
- SMART-SI: Social Interaction test.



The details of all the modules are described in the following chapters of this manual. Please refer to the chapter 16 for a summary of the specific tools provided by each optional module, especially the powerful flexibility of SMART-CS!

Combined with one or more modules, extensions provide additional performance to the video-tracking system in different senses:

- SMART-MA is the Multiple Arenas extension. SMART-MA makes it possible to simultaneously track subjects independently in multiple separated arenas boosting thus the productivity of your lab. Only your computer's performance limits SMART!

- SMART-GA is the Global Activity extension to extend the data acquisition process not only to track the position of the animal but also to detect animal movements even without animal's displacement.

- SMART-TW enables advanced animal detection/tracking capabilities (other than the standard center-of-mass tracking):

  - the TriWise® technology which enables SMART to automatically track the subject's head, center and tail-base. This information is essential to refine the zone transition and permanence calculations, to enable the automatic detection of rearing, rotation and stretching and to calculate other advanced analysis parameters.

  - the Color detection technology which enables SMART to track animals marked with a color. This information is essential for tracking a specific part of the animal body or for a 100% reliable identification of the subjects in a Social Interaction test.

- SMART-SI enables Multiple Subject tracking capability from 2 to more than eight subjects per arena. It allows social behavior analysis (contacts and relative movements between subjects). SMART-SI is an experimental module which will serve as an extension in the SMART-CS experimental module. All other modules are not compatible with SMART-SI.

- SMART-IO allows external devices control to automate tasks such as sinking an island, switching a lamp, closing a door, etc. Please contact your dealer to get specific details on this extension.

Multiple modules and extensions can be combined to fit the needs of your project. Contact your dealer to look for the best combination for you to get explosive results!

The specificities of all the modules are described in all the chapters of the present manual. Please refer to the chapter 17 for a summary of the specific tools provided by each optional extension.

1.2. What's new in SMART 3.0?

- New modular structure: save money and gain convenience by only purchasing what you need!!!!
- Even more user-friendly interface! New Launch assistant and Experimentation Assistant bar for guiding you through the different steps of the experiment.
- Expanded support to live digital image sources such as webcams and DV cameras.
- New built-in RECORDIT video digital recorder for saving the video of your experiments without needing any additional external device.
- Much more easy-to-use and powerful Zones Editor including predefined templates, multi-arena and multi-zone drawing tools, etc.
- New Subject & Group database structure closer to the experimenter logic.
- New Scheduler tool to keep track of your experimental phases, sessions and trials within a single file!
- Powerful combination of tracking (center of masses, TriWise®, color, multiple-subjects) and activity data recording and re-analyzing.
- Independent configuration per each arena: zones definition, detection settings, lighting conditions and time settings.
- Batch data acquisition from multiple digital video files.
- Batch analysis and direct exportation to Excel (1 row per subject reports).
- New customized analysis report designer tool and "Group Evolution" graph to analyze the evolution of a variable along the time for different experimental groups.

1.3. Compatibility with older versions of SMART

1.3.1. Compatibility with SMART v2.x

SMART 3.0 has been completely reengineered and it is **not** compatible with older versions of SMART (2.0 and 2.5) in the following features:

- DT-31xx frame grabber boards.
- System configuration files (SMART.INI)
- Zone definitions.
- Subject lists.
- Tracks.

None of these elements purchased or generated within SMART 2.0 or SMART 2.5 can be used or compared with the equivalent function in SMART 3.0.

Analysis results generated within SMART 3.0 in the same experimental conditions will be similar to the ones generated with older versions of SMART. In some cases, however, analysis results may differ even if data has been acquired in similar conditions.

1.3.2. Compatibility with SMART JUNIOR v1.0

SMART 3.0 is compatible with experimental files generated with SMART JUNIOR v1.0.06 or higher.

Runtime panels will show only the data that was already shown in this version of SMART JUNIOR. The information of any new panels provided by SMART 3.0 will be available only for the new data acquired.

Analysis results generated within SMART 3.0 in the same experimental conditions will be similar to the ones generated with this version of SMART JUNIOR. In some cases, however, analysis results may differ even if data has been acquired in similar conditions.

2. Installation Overview

2.1. System requirements

SMART is a very powerful system that makes an efficient use of the resources available in the computer, especially the microprocessor's cores and memory. We strongly recommend not having any other programs running when SMART is running, to fully utilize the computer's capabilities. The computer must fulfill the following minimum specifications:

- Up to 4 arenas: 2 GHz multi-core processor (Intel Core™2 Duo, AMD Phenom X2 or higher; Celeron processor not supported).

  More than 4 arenas: 3 GHz multi-core processor (Intel i3, AMD Phenom X3 or higher; Celeron processor not supported).

- 2-4 Gb of RAM: SMART is not designed to make use of the RAM memory above the first 4 Gb. The more RAM memory installed in the computer, the longer a data acquisition session can be.

- HD 500 Gb (300 MB of free hard disk space). The freer disk space, the longer the digital video recording can be.

- Graphics: 1280 x 720 pixels and 32-bit true color. Screen text size must be set at 96 DPI (100%).

  Incompatibilities with VIA chipset has been detected so it is extremely recommended to avoid this chipset in the PC's motherboard.

- One free USB port for the software protection key.

- The Teleswitch unit requires an additional free USB 2.0 port to work. Please refer to chapter 12.2 for more details on how to connect and configure the Teleswitch device.

- The optional analog-digital video converter (CONVANAUSB) requires an additional free USB 2.0 port. Please refer to the corresponding chapter in the device's manual for more details.

- Operating systems supported:

  - Microsoft® Windows® 11 - 64 bits.

  - Microsoft® Windows® 10 - 32/64 bits.

- A video source:

  - Live image sources supported:

    - Digital image devices:

- USB standard webcam.
- USB DV camera.
- Analogic-digital video converter (CONVANAUSB).
- In general, WIA-compatible devices with a DirectShow driver included.

Analog-digital video converter requires the use of an analogic camera and, if needed, its corresponding lens. More complex setups may require additional devices to connect to the system. Please contact your dealer for more details on the range of cameras, lenses, and other devices compatible with SMART to fulfil your specific needs!

- Digital video files: SMART is fully compatible with the full range of RECORD-IT!® digital video recording solutions provided by Panlab Harvard Apparatus. Please contact your dealer to get a detailed description of the benefits and advantages of using RECORD-IT!® in combination with SMART.

  In case the digital video files were not recorded with RECORD-IT!®, they must be compatible with SMART. The corresponding CODEC used to record the video file must be installed in the SMART computer to process the particular file format. Please refer to chapter 2.3.2.1 for more details.

- Third-party software required:
  - Microsoft Excel® 2010 or higher (only for reports and data exported in Excel format).

The computer device associated with the Panlab RECORD-IT! Solution for multiple cameras (RECORDTIT4, 8 or 16) is only suitable for video digital recording and then **cannot be used for SMART installation and use**!

2.2. Installing the software

SMART software and the modules and extensions licensed are delivered within a single USB flash key. The key contains the software installation tool, this User's Manual in PDF format and other components required to work in specific conditions.

Due to security reasons of the Windows® operating system, a user with administrative rights is required to install the software and other components. Please contact your IT staff before installing the software.

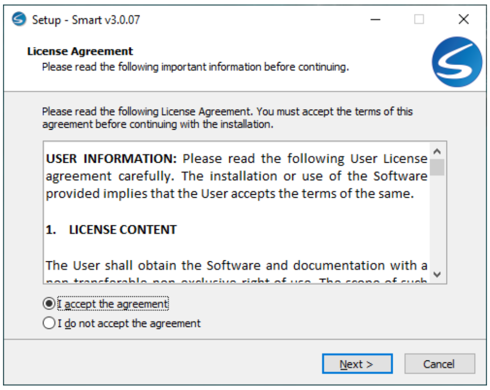
Once you get the administrative rights to install the software, please follow these steps:

- Plug the USB flash key in a free USB port of your computer and wait until Windows® installs it as a new removable drive.

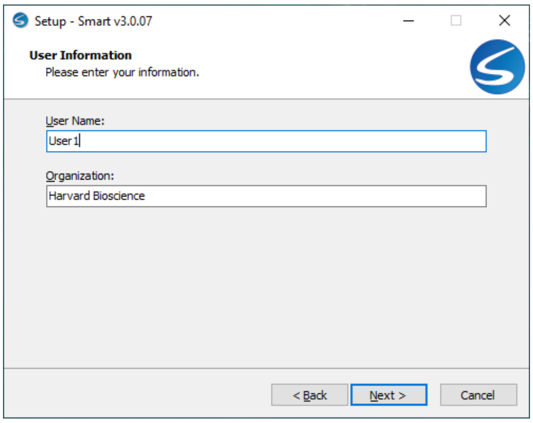
- Access the new removable drive detected and execute the PANLAB.EXE file.

- Click on the "Install SMART v3.0.07" option.

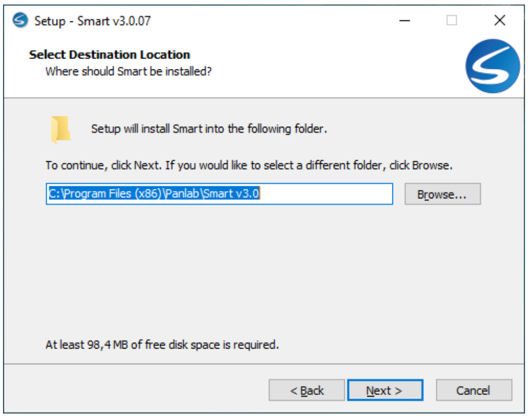
- An installation wizard will appear. Read carefully the "License Agreement" statement and select the "I accept the agreement" to continue the installation of SMART. Then press the [Next] button to start the installation.



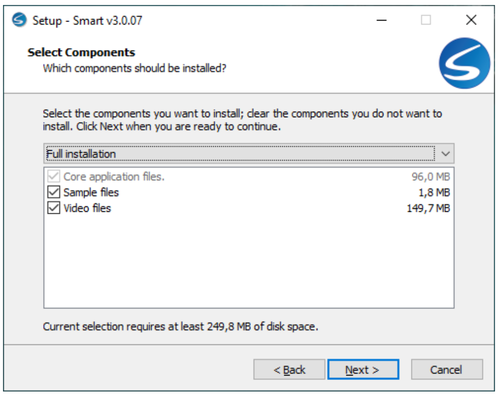
- In the next window, introduce the name of the user and the company in the correct field. Press [Next] button to continue.



- During the installation, process the software is installing in a new folder called [Panlab\SMART v3.0] created under the "Program Files" folder of your hard disk. If desired, the installation program gives you now the option to choose another folder to locate the software. The location of the software is independent of the data folder, which will be defined later by using the corresponding options of the program. Press [Next] button to continue.



- The following window allows selecting the setup type to install as per your needs.



FULL	Installs SMART and a set of video sample files.
COMPACT	Installs only SMART.
CUSTOM	Installs SMART and allows you to select whether to install video sample files or experiment samples to your hard disk.

Installation types and included components.

- Press the [Next] and [Install] buttons until reaching the [Finish] button. A new shortcut will appear on your desktop. Use it to start the program later.

2.2.1. The USB protection key

A software protection key is a device used to prevent software from unlawful use. This small part is connected to the computer via a free USB 2.0 port. Only one key is provided per purchased license, so it is not possible to record data in more than one computer at a time.

Please DO NOT remove or modify any file stored within the USB flash key, especially the regkey.dat file which stores the information regarding your license of use.

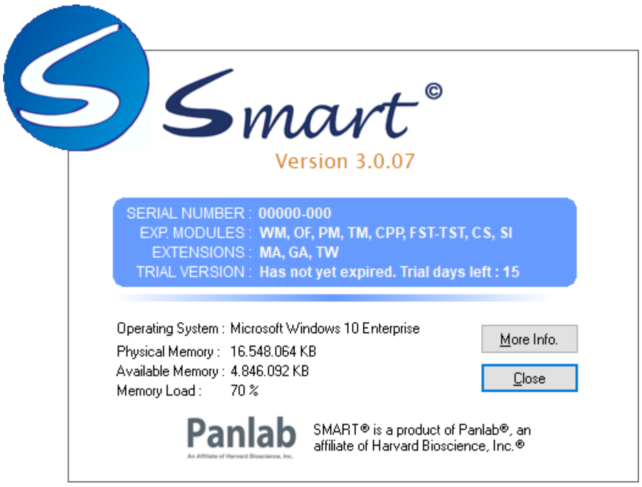
To make use of the protection key, make sure it is plugged in before SMART is started. If no protection key is present, the software will work only for analysis and data acquisition will not be possible.

2.2.2. Testing SMART: the trial period

This section only applies if you have acquired a trial version of SMART available for download at http://www.panlab.com/.

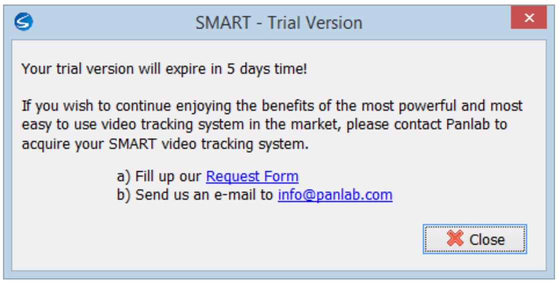
The trial period is of **15 days** counted from the first time SMART is executed and is intended for testing purposes. During this period, SMART will be fully functional, this means that every module and every extension will be available.

The trial period information can be accessed throughout the Help – About menu option:

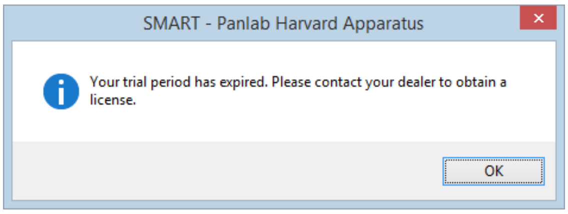


The "Trial Version" field shows the status of the trial period.

A week (7 days) before the trial's expiration date, SMART will show a warning that the trial period will expire, with instructions on how to purchase your licensed edition of the software.



If the trial period is definitely expired, a warning message is shown, and SMART will no longer execute.



If required, in special cases, the trial period can be extended upon special request. Please contact your dealer for further details.

2.2.3. Installing the Remote Control unit

If a wireless remote-control unit (a.k.a. Teleswitch) was acquired, please refer to the chapter 12.2 for more details on how to install and use it.

2.3. Installing the image source

As a video-tracking system, SMART processes the sequence of images (frames) coming from a source and extracts the information related to the animal behavior (position, speed, events, etc.).

SMART can process images coming from two types of sources:

- Live image, using external image sources such as video camera, VTR or DVD player (through a frame grabber board or CONVANAUSB device).
- Digital video files, which store experiment trials previously recorded.

2.3.1. Live image sources

Live image sources are external devices that provide the computer with the sequence of images at the same time in which the animal is moving within the arena with a variable precision up to 25 frames per second (fps). Each frame is generated by converting the color of the real scene into a matrix of digital values called pixels. SMART then analyzes each pixel of each frame to get all the information and provides it to you in a more convenient manner.

Live image source	Cost	Quality	Flexibility
Webcam	Low	Medium-High	Low
Analog-digital converter	Low	Medium	Medium
Digital Camera	Medium- High	High	Medium

Comparison of supported live image sources.

Except standard webcams (based on digital technology), the rest of the supported image sources allow a wide range of setups: from simple arrangements based on a single live camera to complex systems with multiple live cameras, digital video recording devices, input selectors and long-distance cables.

2.3.1.1. Camera considerations

SMART can be used with a wide variety of standard analogic cameras or user-defined image sources (Infrared cameras, camcorder, WIA-compliant USB camera, webcams, etc.). The choice of the camera depends on the requirements of your experimental setup.

The following main characteristics must be considered:

- Frame rate

  A suitable frame rate for rat and mice tracking is 16 frames/sec (16 fps). SMART increases this rate up to 25 fps (depending on the live image device used) so that the requirements of many of your experimental projects are fulfilled more than enough.

Live Image Source	Max. Frame Rate
Webcam	16 fps
Analog-digital converter	25 fps
Digital Camera	25 fps

  However, both the camera and the recording unit used with the system should allow playing/recording the experiment with this rate. The standard image sources and recorders provided together with SMART have been thoroughly tested by Panlab Harvard Apparatus to assure that they fulfil this requirement.

  A higher frame rate can be achieved by recording a video with a higher frame rate and then processing it with SMART. For more details about important factors to be considered while recording digital video files, please refer to chapter 3.2.5.

- Resolution and angle of vision (lens)

  The precision/resolution of the detection of the subject to be tracked will depend on the resolution of the camera (and the frame grabber board if used), the maximal angle of vision of the lens installed and the distance between the camera and the experimental area. The subject must be "big" enough (and lighting conditions should be quite good to reduce the use of filters) to be detected and tracked.

  The standard camera provided by Panlab is associated with a standard lens that has maximal angle of vision of 90 degrees (focal length of 3 mm) radial of the camera. This angle of vision is suitable for most of the standard experiment conditions as it allows receiving the image of a 4 x 4 m area in a room with 2.5 m ceiling height.

  SMART does not work with the tangential distortion and the radial of the camera. For this reason, we recommend the camera to be as far as possible of the arena in a zenithal position, avoiding the use of wide-angle lens.

- Color / B&W / Infra-red

  Standard analogic cameras provided with SMART are in color, but it is not a crucial property for the experiment. However, the compatibility among all the devices in your setup must be assured so please contact your dealer to select the best option for your specific needs.

It is very important to optimize the contrast between the subject and the experimental background to ensure optimal detection and tracking. Many times, in standard experiments involving mazes, a better contrast is obtained with B&W cameras.

Infrared cameras are recommended when working with very low lighting conditions or in complete darkness.

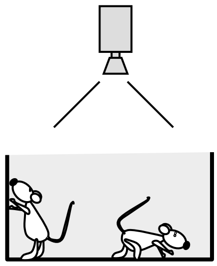
- Lens adjustments

When working with digital cameras (camcorder), it is very important to deactivate any automatic adjustment (aperture, zoom, focus) because the lens settings must remain unchanged during all tracking process.

- Camera positioning

The camera must be fixed above the experimental area in a zenithal position ensuring that it will stay immobile along the whole experiment. Any movement of the camera during the experiment may strongly impact the tracking process.

Set the light obstructer, the zoom and focus of the camera must be set in a manner to obtain an image as the more well-defined as possible. In case of using digital webcams, disable any automatic adjustment (such as auto-focus or lighting auto-adjustment). All these settings must remain unchanged during the tracking process.



Record-it

It is strongly recommended to record the image of the experiment in a video digital file using the RECORD-IT! solutions provided by Panlab Harvard Apparatus. These options provide an opportunity to open again the video of the experiment afterwards and to track the animal with other detection settings.

2.3.1.2. Installing a webcam

Standard USB webcams are one of the mostly used live image sources. They offer a reasonable trade-off between image quality and cost. However, due to technical limitations of the USB communication protocol, webcams cannot be used in complex setups with more than one camera or with long distances between the computer and the arenas.

As Panlab Harvard Apparatus recommends the use of the **Logitech HD C3xx** series of webcams, this chapter will cover the installation procedure for this specific model.

Though this model of webcam comes with its specific device drivers, they are NOT required by SMART so you **only have to plug the webcam in a free USB 2.0 port** and wait for Windows to automatically detect it.

Other standard USB webcams may be installed following a similar procedure which is described in detail in the corresponding User's Manual.

Please note that extra tools included within some standard USB webcams may affect the tracking process, especially those related to the auto-focus, automatic brightness and contrast and face tracking. Make sure that these options are disabled before using your webcam for data acquisition.

2.3.1.3. Installing an analog-digital converter

The analog-digital video converter (CONVANAUSB) enables the use of the analogic image technology by digitalizing the incoming images of analogic sources.

The analog-digital video converter (CONVANAUSB) is an optional accessory that can be purchased with your SMART system. Please contact your dealer to know the advantages of this accessory and how to acquire it.

Only one analog-digital video converter (CONVANAUSB) can be plugged in into the computer.

For this device to operate correctly, first the corresponding drivers must be installed. Four different versions of the analog-digital video converter have been released, which require different drivers. Before continuing, please check which version you have in your system:

Version 1	Version 2	Versions 3-4
		

To install **Version 1** please refer to chapter 0. To install **Version 2** or **Versions 3-4** please refer to chapter 0.

Installing Version 1 of the Analog-Digital Converter

In order to install the device in Windows® systems, please follow the next steps:

1. **IMPORTANT: Do not plug the device into any USB port before step nr. 7 of this installation guide.**

2. Please make sure to have administrative privileges in the computer in which the device will be installed. Contact your IT staff to confirm this issue before continuing with this procedure.

3. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).

4. Select the "Hardware Drivers" option.

1. Enter the **"Analog Camera -> CONVANAUSB Drivers** ->**Version 1**" folder and execute the correct .exe file (32 or 64 bit depending on the version of Windows). Then follow all the steps with the default options.

5. Click the '**Finish'** button to finish the installation.

6. Plug the device to a free USB 2.0 port. Make sure to remove the yellow label from the USB end of the cable first.

7. Wait for the Windows Device installation assistant to launch and follow the default steps until finishing.

8. To use the device, go to **Image Settings** (for more information about **Image Settings**, refer to chapter **5**) and select the device **Analog-Digital Converter.**

Installing Version 2, 3 or 4 of the Analog-Digital Converter

In order to install the device in Windows® systems, please follow the next steps:

1. **IMPORTANT: Do not plug the device into any USB port before step nr. 7 of this installation guide.**

2. Please make sure to have administrative privileges in the computer in which the device will be installed. Contact your IT staff to confirm this issue before continuing with this procedure.

3. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).

4. Select the "Hardware Drivers" option.

5. Enter the **"Analog Camera -> CONVANAUSB Drivers** ->**Version 2 to 4**" folder and execute the .exe file. Then follow all the steps with the default options.

6. Click the 'Finish' button to finish the installation. In some cases, you will need to restart your computer.

7. Plug the device to a free USB 2.0 port. Make sure to remove the yellow label from the USB end of the cable first.

8. Wait for the Windows Device installation assistant to launch and follow the default steps until finishing.

9. To use the device, go to **Image Settings** (for more information about **Image Settings**, refer to chapter **5**) and select the device **Analog-Digital Converter.**

2.3.1.4. Installing a digital camera

SMART works with a wide variety of digital cameras (provided that the relevant driver is correctly installed), but we only ensure total compatibility with the digital USB 2.0 cameras manufactured by IDS and The Imaging Source (TIS). Panlab-Harvard Apparatus can only provide after-sales support on the SMART camera management if used with the models recommended in this User Manual.

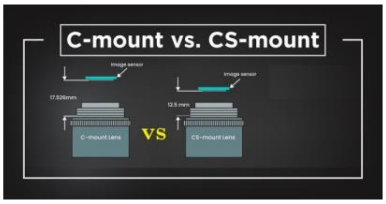
Depending on the configuration purchased we provide 3 USB cable length options with our cameras: 3, 5 or 8 m.

The digital cameras provide high-resolution images at frame rate of up to 40 fps. The quality of the images and the minimal installation requirements make the digital cameras ideal for video tracking.

Installing a TIS Digital Camera

To install a TIS digital camera in Windows® systems, please follow the next steps:

1. Unpack the camera and remove the CS/C lens adapter ring supplied with the camera before mounting the lens.



2. Plug the device to a free USB 2.0 or USB 3.0 port. Once plugged in, Windows recognized that there is a connected device, but it will be necessary to install the drivers in order to manage the camera.

3. Please make sure to have administrative privileges in the computer in which the device will be installed. Contact your IT staff to confirm this issue before continuing with this procedure.

4. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).

5. Select the "Hardware Drivers" option.

6. Enter the "**Digital Cameras -> TIS USB 2.0 Digital Camera"** folder and execute the .exe file. Then follow all the steps with the default options.

7. Click the '**Finish'** button to finish the installation.

8. Wait for the Windows Device installation assistant to launch and follow the default steps until finishing.

Installing an IDS Digital Camera (Legacy mode)

In order to install a digital camera in Windows® systems, please follow the next steps:

2. Unpack the camera, remove the silver O-ring from the objective and mount the lens. If the silver O-ring is not removed, the image received from the camera could be blurry.

3. **IMPORTANT: Do not plug the camera into any USB port before step nr. 7 of this installation guide.**

4. Please make sure to have administrative privileges in the computer in which the device will be installed. Contact your IT staff to confirm this issue before continuing with this procedure.

5. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).

6. Select the "Hardware Drivers" option.

7. Enter the "**Digital Cameras -> IDS Digital Camera"** folder and execute the correct .exe file (32 or 64 bit depending on the version of Windows). Then follow all the steps with the default options.

8. Click the '**Finish'** button to finish the installation.

9. Plug the device to a free USB 2.0 or USB 3.0 port.

10. Wait for the Windows Device installation assistant to launch and follow the default steps until finishing.

11. To use the device, go to **Image Settings** (for more information about **Image Settings**, refer to chapter **5**) and select the corresponding camera.

2.3.2. Digital video files

Advances in multimedia technology allow recording experiments into a digital support which offers the following advantages:

- Facilitates handling and sharing information.
- Minimizes storage space costs.
- Improves image quality and durability.

Digital video files can be recorded using the RECORD-IT! solution from Panlab Harvard Apparatus. Generated video files can then be copied to a CD or a DVD disk or can be sent by e-mail or by a local area network to a computer where SMART is installed to be analyzed.

SMART provides you with an embedded module of RECORD-IT! for recording a single camera connected through any of the live image sources described at the chapter 2.3.1. Please refer to the chapter 5.3 for more details on how to record digital video files using this embedded module.

SMART can process these files offline in the same way as it does online, that is, with external live image sources.

To be processed by SMART, digital video files must be recorded at Constant Frame Rate (CFR), and their Frame Rate cannot be greater than the original one, which means that videos that have been accelerated using an external tool are not supported.

2.3.2.1. CODECS

Digital video files can store large image sequences into relatively small files. To do that, digital recorders make use of compression and codification methods that reduce the final size of the file.

Compression and codification processes are carried out by a special software component called CODEC (CO-mpressor/DEC-ompressor) that should be installed both on the recorder and in the reader devices.

Each CODEC is capable of dealing with a variety of digital video formats, according to vendor specifications. That is why SMART will be able to manage digital video files which format could be understood by the CODECs installed on the computer.

Please note that Microsoft Windows® operating system includes CODECs for several standard video formats such as MPEG-4 or Indeo®. SMART installation software also includes some additional CODECs to process the video recorded.

Installing additional CODECs will allow SMART to process any digital video format, for example DIVX or SVCD.

As the CODEC is responsible for providing SMART with the image sequence to process, the CODEC's efficiency may impact on the precision of SMART calculations. Most CODECs discard some of the original data to reduce the file size. Although a CODEC tries to remove only portions of the data that humans are not likely to note, if the compression level of a video file is too high, portions of the removed data will be easily notable, and accuracy will be lost. Therefore, when using CODECs to compress your video, there is a trade-off between quality and file size.

PANLAB suggests the XviD implementation provided within the software or, if possible, acquiring the commercial edition of the CODEC used.

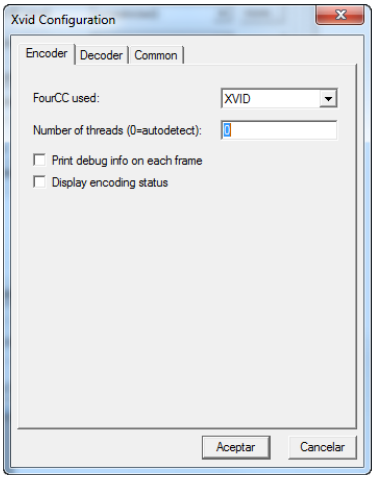
2.3.2.2. Installing the XviD CODEC to record and work with the sample digital video files.

All SMART 3.0 platforms are provided with a built-in RECORDIT! Function for recording the image of the experiment in a video digital file. The experiment recording process can be done independently or simultaneously with the tracking process.

To enable the SMART embedded digital video recording function and also to work with all video examples provided with SMART, the XviD codec must be installed. Follow these steps:

1. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).
2. Select the "Digital Video Codecs" option.

3. Enter the "Xvid Codec" folder and execute the "Xvid Codec.exe" file. Then follow all the steps with the default options.
4. Click the 'Finish' button to finish the installation.
5. Execute the "Configure Encoder" tool located at the Start > All programs > Xvid folder.
6. Press the "Other options…" button located at the bottom of the "Xvid Configuration" window.
7. Uncheck the option "Display encoding status" and press the "Accept" button.



8. Press the "Accept" button in the "Xvid Configuration" window.

Now your system is ready to record digital video files and deal with the video examples included. Please refer to the chapter 5.3 for more details on how to use the SMART embedded digital video recording tool.

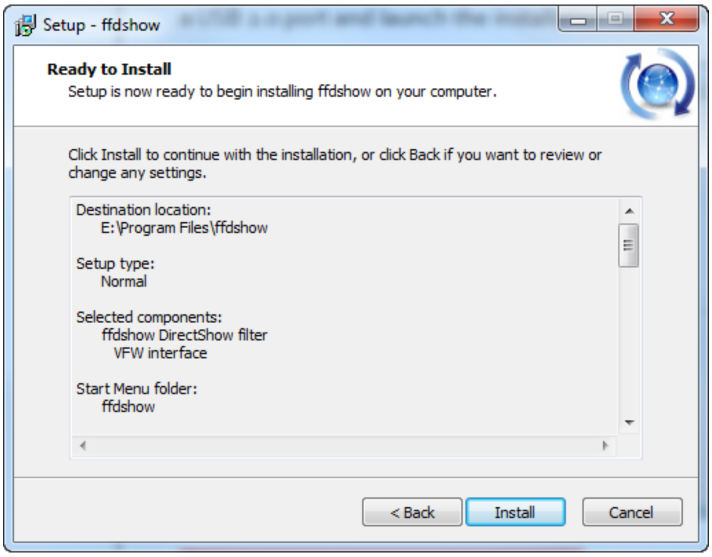
2.3.2.3. Installing CODECS to process Record-It! videos.

In order to open the video files generated with the RECORD-IT! solution properly, an MPEG-4 video decoder must be installed on the SMART computer.

To install the required video codec, plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).

1. Plug the installation key of SMART into a USB 2.0 port and launch the installation tool (PANLAB.EXE).
2. Select the "Digital Video Codecs" option.

3. Enter the "Record-It! Support" folder and execute the "Ffdshow Codec.exe" file. Then follow all the steps with the default options until finishing the installation.



2.3.2.4. Supported and unsupported video file Formats

SMART supports all common digital video formats. It contains proprietary decoding systems that are able to decode most of the existing video formats. However, in some special cases, due to the fact that there are innumerable types of formats, it is possible that the digital video file cannot be opened by SMART, that it does not playback correctly or that it requires a special codec to be installed on the system. Please refer to chapter 2.3.2.1 for more information about codecs.

The following is a subset of the most common formats supported by SMART:

Video Format	Usual file extensions
Audio Video Interleave	*.avi
Windows Media Video	*.wmv, *.asf
QuickTime	*.mov, *.qt
Moving Picture Experts Group	*.mpg, *.mpeg, *.mp4, *.m4v, *.3gp
Matroska Multimedia Container	*.mkv

The above formats contain video streams that may be compressed with various different codecs. SMART supports the codecs specified in the following list. Additional codecs are supported if the corresponding codec is installed in the system.

8088flex TMV	LCL (LossLess Codec Library) MSZH
Amazing Studio PAF Video	LOCO
AMV Video	LucasArts SANM/Smush
ANSI/ASCII art	lossless MJPEG
Apple Intermediate Codec	Microsoft ATC Screen
Apple MJPEG-B	Microsoft Expression Encoder Screen
Apple ProRes	Microsoft RLE
Apple QuickDraw	Microsoft Screen 1
Asus v1	Microsoft Screen 2
Asus v2	Microsoft Video 1
ATI VCR1	Mimic
ATI VCR2	Miro VideoXL
Auravision Aura	MJPEG (Motion JPEG)
Auravision Aura 2	Mobotix MxPEG video
Autodesk Animator Flic video	Motion Pixels video
Autodesk RLE	MPEG-1 video
Avid 1:1 10-bit RGB Packer	MPEG-2 video
AVS (Audio Video Standard) video	MPEG-4 part 2
AYUV	MPEG-4 part 2 Microsoft variant version 1
Beam Software VB	MPEG-4 part 2 Microsoft variant version 2
Bink Video	MPEG-4 part 2 Microsoft variant version 3
Bitmap Brothers JV video	Nintendo Gamecube THP video
y41p Brooktree uncompressed 4:1:1 12-bit	NuppelVideo/RTjpeg
CamStudio	On2 VP3

CD+G	On2 VP5
CDXL	On2 VP6
Chinese AVS video	On2 VP7
Discworld II BMV Video	VP8
Canopus Lossless Codec	VP9
Cinepak	Pinnacle TARGA CineWave YUV16
Cirrus Logic AccuPak	Prores
CPiA Video Format	Q-team QPEG
Creative YUV (CYUV)	QuickTime 8BPS video
Deluxe Paint Animation	QuickTime Animation (RLE) video
DNxHD	QuickTime Graphics (SMC)
Duck TrueMotion 1.0	QuickTime video (RPZA)
Duck TrueMotion 2.0	R10K AJA Kona 10-bit RGB Codec
DV (Digital Video)	R210 Quicktime Uncompressed RGB 10-bit
Dxtory capture format	Raw Video
Electronic Arts CMV video	RealVideo 1.0
Electronic Arts Madcow video	RealVideo 2.0
Electronic Arts TGV video	RealVideo 4.0
Electronic Arts TGQ video	Renderware TXD (TeXture Dictionary)
Electronic Arts TQI video	SGI RLE 8-bit
Escape 124	Sierra VMD video
Escape 130	Silicon Graphics Motion Video Compressor 1 (MVC1)
FFmpeg video codec #1	Silicon Graphics Motion Video Compressor 2 (MVC2)
Flash Screen Video v1	Smacker video
Flash Screen Video v2	SMPTE VC-1
Flash Video (FLV)	Sony PlayStation MDEC (Motion DECoder)
Forward Uncompressed	Sorenson Vector Quantizer 1
Fraps	Sorenson Vector Quantizer 3
Go2Webinar	Sunplus JPEG (SP5X)
H.261	TechSmith Screen Capture Codec
H.263 / H.263-1996	TechSmith Screen Capture Codec 2
H.263+ / H.263-1998 / H.263 version 2	Theora
H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10	Ut Video
HEVC	v210 QuickTime uncompressed 4:2:2 10-bit
HNM version 4	v308 QuickTime uncompressed 4:4:4
HuffYUV	v408 QuickTime uncompressed 4:4:4:4
HuffYUV FFmpeg variant	v410 QuickTime uncompressed 4:4:4 10-bit
IBM Ultimotion	VBLE Lossless Codec
id Cinematic video	VMware Screen Codec / VMware Video
id RoQ video	Westwood Studios VQA (Vector Quantized Animation)
IFF ILBM	Windows Media Image
IFF ByteRun1	Windows Media Video 7
Intel H.263	Windows Media Video 8
Intel Indeo 2	Wing Commander III / Xan
Intel Indeo 3	Wing Commander IV / Xan
Intel Indeo 4	Winnov WNV1
Intel Indeo 5	WMV7
Interplay MVE video	YAMAHA SMAF
J2K	Psygnosis YOP Video
Karl Morton's video codec	YUV4
Lagarith	ZeroCodec Lossless Video

SMART does not support videos with DRM (Digital Rights Management) protection.

Incompatibilities with **K-Lite Codec Pack** have been detected that may affect the acquisition process in .avi digital video files. It is strongly recommended to avoid installing this codec pack.

3. Video-Tracking previous considerations

SMART is a very powerful and flexible video-tracking system, which can be used in a wide variety of behavioral experiments.

Below is given a list of steps that must be fulfilled to perform the experiments. The list has to be considered as a general guideline given that the order of these steps can be changed depending on the user's experimental stage:

- Experimental area preparation
- Video source selection
- Configurations
- Distance calibration
- Detection settings
- Zones definition
- Experiment subjects data base
- Project scheduler/planning
- Timing configuration
- Track recording (Data acquisition)
- Track analysis & data report generation

3.1. How does a video-tracking work?

Classic video-tracking systems are designed to automate the typical observational task required by a scientific experiment. In behavioral experimentation, video-tracking systems automatically detect and register the position/displacement of a specific subject within a specific experimental area (arena).

The techniques used for such a purpose can be divided in two main modes: tracking and global activity (see the Detection mode chapter 8.2 for more details about each technique used).

A deeper understanding of the video-tracking basic techniques is very important for:

- Helping users choose the most appropriate technique for their desired studies.
- Educating users to how the configurations (experimental conditions, software settings...) may affect the relevancy of the data obtained and the interpretation of the results.

3.2. Implications for experiment preparation and settings

Some important considerations have to be taken into account when working with a video-tracking system.

3.2.1. Lighting conditions

Lighting is an important environmental condition that has to be finely controlled in order to obtain pertinent data in SMART. Bad lighting configuration can hinder obtaining exploitable tracks.

Lighting conditions can be adjusted by acting on the experimental area (light chosen, position, intensity) and by using some available functions in the SMART software.

Especially regarding the lighting conditions, an ideal setup should satisfy the following aspects:

- Work in a controlled environment:

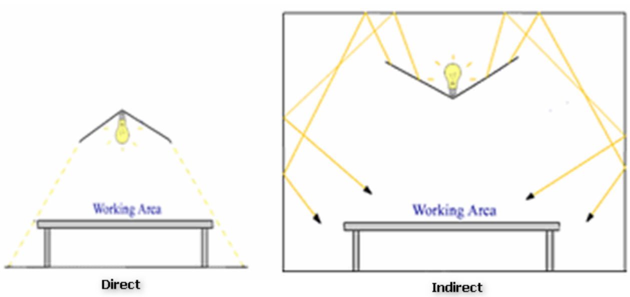
  The lighting conditions have to be specifically controlled with no interference from the uncontrolled sources of light (e.g., sunlight). In consequence, the room where the experiment is held should be a room without windows, or as free from exterior light as possible. Interior rooms are perfect for video-tracking purposes.

- Avoid fluorescent light:

  The day light conditions can be easily simulated with standard lamps or bulbs. Whenever possible, avoid using fluorescent lamps, as these are susceptible to changes in power supply frequency and offer light concentrated in the blue area of the spectrum.

- Use indirect illumination:

  NEVER illuminate the scenery directly unless it is unavoidable; direct illumination can easily produce reflections. Therefore, always use indirect illumination, i.e., illuminate the ceiling instead of directly illuminating the scenery.



- Special recommendations for Water Maze experiments:

  Lighting conditions are critical especially in water maze experiment. Direct lighting provokes reflections on the surface of the water, which may difficult animal detection.

Some suggestions to improve lighting conditions:

- Curtain:

  A white shower curtain can be placed around the pool and the light given through the curtain. The advantage of this configuration is that (1) it avoids light reflection, (2) it allows the water maze to be isolated from external influences and (3) it allows spatial cues to easily be placed the spatial cues on the curtain for the evaluation spatial memory performance.

- Black pool:

  If working with white animals, it may be preferred to use a black colored pool with a black colored platform.

- Marked Animals:

  A temporary black mark can be made on the back of white animals to optimize video tracking with white animals in white colored pools.

3.2.2. Mazes & enclosures

SMART can work with a wide range of different mazes and enclosures: plus maze, water maze, Barnes maze, open-field area. It can also be used in any user-defined areas. Mazes and experimental enclosures are available in different materials, sizes and colors. Please contact your dealer to look for the best solution for your experimental requirements.

Some indications about how to choose the adequate enclosure for your experiments are:

- Material

  We recommend using an enclosure built with a material which does not retain odors after washing, as Plexiglas. Indeed, the odors left by the previous animal placed into the apparatus may affect the responses of the subsequent. For this reason, we strongly recommend avoiding wooden.

- Size

  The sizes of commercially available enclosures are somewhat standard for adult mice (25-30g) and rats (250-300g). For young or old animals, depending on the dealers, it may be possible to order special enclosures with user-requested sizes. The perfect size for video-tracking studies is “when the experimental area can be seen entirely through the image of the camera”.

- Colors and finish

When using a video-tracking system, the better the contrast between the animal and the enclosure, the better the detection of the animal and the higher the reliability and precision of the results obtained (distance covered, speed, displacement tracking). The color of the enclosure used, and its finish are then of great importance. It is preferred for the color to be matte, minimizing reflections due to the lighting as these can induce artifacts within the video and impact the tracking results.

Exceptions do exist and are to be followed when the color of the background is not critical for the experiment as in:

- If only white animals will be used in the experiment, we recommend using an enclosure with black color floor.

- If only black animals will be used in the experiment, we recommend an enclosure with light grey or white color floor.

- If animals with different colors will be used in the same experiment (transgenic mice for instance), we recommend an enclosure with light grey color.

- IR-illumination through translucent floors.

  When using IR-illumination through translucent floors, the room illumination can be set to meet the requirements for the behavioral aspect of the experiment independently from the IR-illumination, which needs to meet the requirements of the video tracking system. Since animals do not perceive the IR-light, they are not disturbed by the IR-light settings and, vice versa, since the camera lens is equipped with an IR-filter the tracking is not altered by the room light setting. Furthermore, the contrast of the animals' dark silhouettes on a bright background is very much suited for reliable tracking.

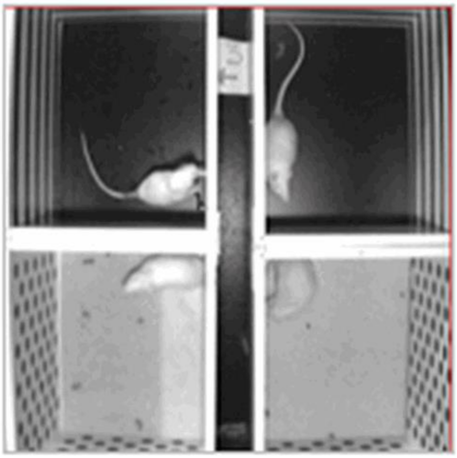
3.2.3. Image noise

Due to the nature of basic video-tracking systems, image noise can produce little variations of the center of mass that could imply a considerable overestimation of the total distance travelled, even in an animal without displacement!

This is a common phenomenon easily corrected by filters available in the Detection Settings and in the Analysis sections of SMART.

- Special case: zones with different contrast – zones with shadows/reflections

  Special care should be taken with the settings and interpretations of the results when working with configurations in which the contrast between the color of the floor and the color of the animal is very low, as it is the case in Black & White boxes or in some place preference boxes.



In these specific conditions, the volume of pixel detected in the low-contrast compartment may be lower than the volume of pixels detected in the high-contrast compartment.

The mean of all the pixels detected is taken into account for tracking the animal. The tracking in the zone with the lower amount of pixels may produce more "vibrations" than the tracking in the good contrast zone in which a greater number of pixels is taken into account. Good contrast is necessary to avoid the false impression that the animal displayed higher locomotor activity in the low-contrast compartment.

Same problems may occur in experiments performed with direct illumination as this lighting is known to cause shadows or light reflections in the experimental area and artifacts.

- Solutions proposed:
    - Improve lighting conditions for avoiding any shadows and light reflection.
    - Use the SMART option allowing setting different brightness/contrast conditions in specific zones for that the volume of pixels detected will be the same in all the experimental areas or between each compartment (for details see chapter 8.1)
    - Use the SMART advanced options for filtering and smoothing in the Detection Settings and Analysis sections (for details see chapters 8.2.1.3 and 14.11.4.6).

3.2.4. Interlaced Video

The images provided by most analogic cameras are interlaced. Interlaced video is a technique for doubling the perceived frame rate of a video display without consuming extra bandwidth. The interlaced signal contains two fields of a video frame captured at two different times. Although this enhances motion perception to the viewer, this technique produces images which are not optimal for video tracking, especially in case the subject is moving fast horizontally across the image.

The following is an example of a normal image compared to an interlaced image:

Normal Image

Interlaced Image

- Solutions proposed:
    - For all the devices supported by SMART that use analogic cameras (CONVANAUSB), there is available a deinterlacing filter that decodes interlaced images back to normal images. For information on how to activate this filter, please refer to chapter 5 of this user manual.
    - The use of digital cameras that do not interlace images.

3.2.5. Recording digital video files

SMART is provided with embedded video digital recording capabilities which represent a useful tool for most of the experiments performed in Neuroscience research (short tests conducted in mazes).

For more advanced needs (long duration experiment, multiple camera needs...), SMART is also fully compatible with the full line of external RECORD-IT! digital video recording solutions provided by Panlab Harvard Apparatus. Please contact your dealer for a detailed description of the benefits and advantages of using external RECORD-IT! options in combination with SMART.

The following considerations must be taken into account when creating a digital video file using the embedded RECORD-IT! module of SMART or using an external video recording unit.

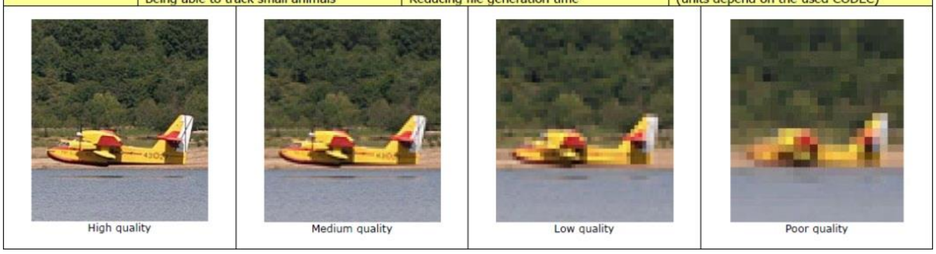
- CODEC performance

  In case that the digital video files are not recorded with RECORD-IT!, they must be compatible with SMART. The corresponding CODEC used to record the video file must be installed in the SMART computer to process the particular file format. Please refer to chapter 2.3.2.1 for more details.

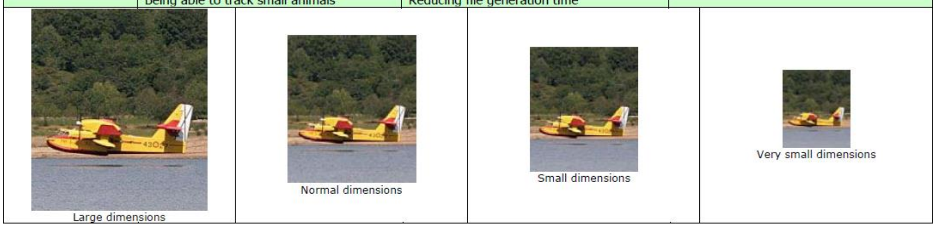
  The performance of the CODEC used by the recorder device influences the properties of the created digital video file: (i) image quality, (ii) image dimension, (iii) frame rate and (iv) time needed to generate the digital video file.

  Choosing and configuring the CODECs adequately will then allow optimizing the tracking process by the SMART video-tracking software.

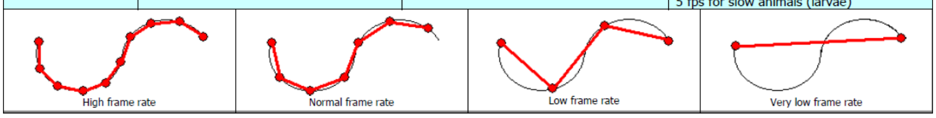
Property	Choose higher values for ..	Choose lower values for ...	SMART recommended value
Image quality	A better precision of the calculations Being able to track small animals	Reducing file size Reducing file generation time	80% / 500 kbps (units depend on the used CODEC)



Property	Choose higher values for ..	Choose lower values for ...	SMART recommended value
Image dimensions	A better precision of the calculations Being able to track small animals	Reducing file size Reducing file generation time	640x480 (pixels) or similar



Property	Choose higher values for ..	Choose lower values for ...	SMART recommended value
Frame rate	A better precision of the calculations A better quick movements detection	Reducing file size Reducing file generation time	25 fps for quick animals (fly) 15 fps for normal animals (mouse / rat) 5 fps for slow animals (larvae)



- Computer's performance

  If the digital video file is recorded within SMART using the embedded module of RECORD-IT!, a much higher computer's performance is required. Please check that the specifications of your computer fulfill the system requirements described in the chapter 2.1.

- Background snapshot

  In the standard detection modes use by SMART (centre-of-mass, TriWise modes) a snapshot of the experimental background (without animal) must be taken before starting tracking. This snapshot will serve as reference. The differences between the experimental image (with animal) and the reference image (without animal) will be materialized in pixel format (black dots) and processed by SMART; the rest (which is identical to the reference image) will be ignored by SMART (white).

  Given these considerations, it is highly advisable to have the first seconds (at least 1 s) of the digital video file recorded with the image of the experimental background recorded without animals. If this is not fulfilled, SMART provides a **Snapshot Editor** tool to remove the animal and other artifacts from the image. Please refer to the chapter 8.2.6. for more details on this tool.

- Brightness & contrast

  Although SMART offers the possibility to adjust brightness and contrast in a live image as well as in a digital video file, it is very important to set adequate lighting conditions before recording the experiment.

  Use the Test mode of SMART to check your environmental conditions before recording the digital video files. Please refer to the chapter 8.2 for more information on how to use the Test mode in each detection mode provided by SMART.

- Minimum video length

  At least 5 seconds of video must be recorded to allow SMART to analyze it.

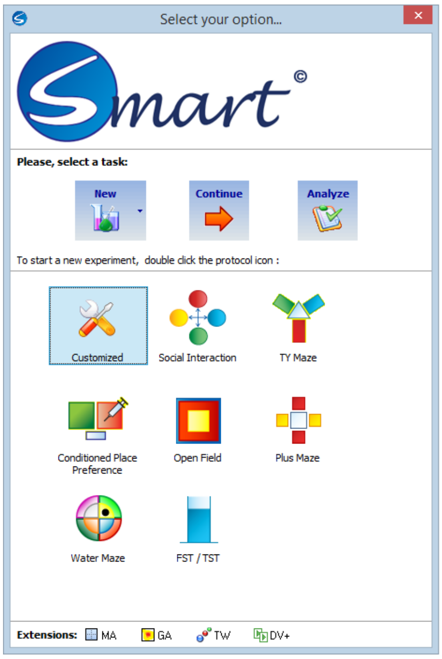
- Max video length

The SMART video-tracking system has mainly been developed to manage short-duration behavioral experiments such as maze experiments. When used in a computer filling the requirements indicated in the chapter 2.1, the performance of the system is optimal for a video duration **not longer than 2 hours**. Recording videos with more than 2 hours duration ensuring optimal resource for its analysis (track data acquisition and data reports) would depend on other factors such as the performance of the computer, the number of trials etc.).

4. Beginning with SMART

4.1. Starting Assistant

When SMART is launched a **Starting Assistant** tool is shown on the screen:



All modules and extensions licensed vs. only the Water Maze experimental module licensed.

The **Starting Assistant** tool allows you to:

- Start a new experiment.
- Continue with a previously saved experiment.
- Analyze the data acquired in a previously saved experiment.

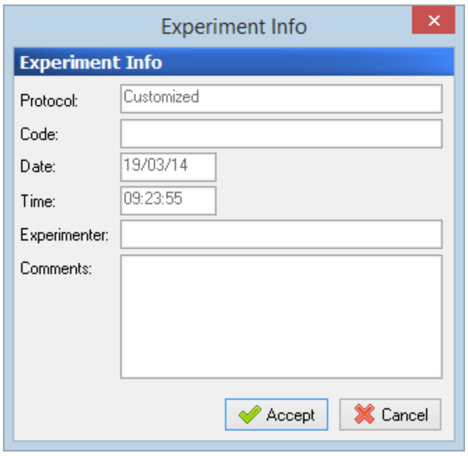
The Starting Assistant shows the list of modules and extensions available in your license.

4.1.1. Starting a new experiment

To start a new experiment:

1. Select the **New** task.
2. Make double click on the icon of the protocol which the new experiment should follow (Alternatively you may also select the protocol first and then double click on the **New** task).

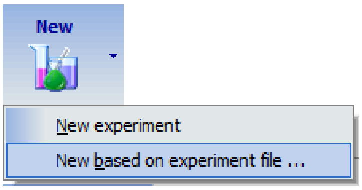
3. Enter details in the **Experiment Info** dialog.



4. Press the **Accept** button.

4.1.1.1. Starting a new experiment based on an already existing

A new experiment can be also created from an existing one so that most of the information and configurations can be reused. To do so:



1. Click on the arrow located at the right side of the **New** button.
2. Select the **New based on experiment file…** menu option.
3. Locate and select the file in which the base experiment is stored.
4. Press the **Open** button.
5. Enter details in the **Experiment Info** dialog.
6. Press the **Accept** button.

A new experiment is created importing all the following elements from the base experiment:

- Image source
- Calibration
- Arenas
- Zones definition
- Detection settings
- Time settings
- Scheduler's phases and sessions

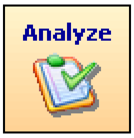
The subject list is not imported automatically but it can be imported manually later. Please note that registered trials acquired in the original experiment are not imported in the new one.

4.1.2. Continuing an experiment

To continue with an already existing experimental file:

1. Select **Continue**.
2. Locate and select the desired folder and experimental file.
3. Press **Open** to load the experimental file.

Most recently used experimental files are provided within the dropdown button of the **Continue** button.



4.1.3. Analyzing an experiment

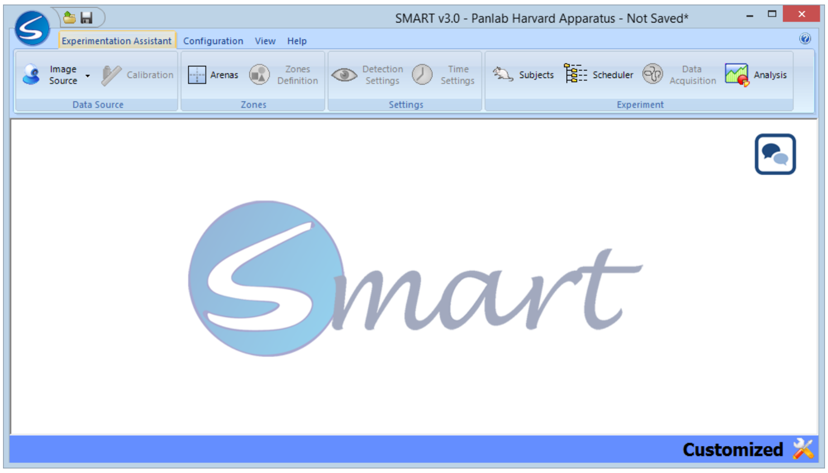
To analyze the session contained in an existing experimental file:

1. Select the **Analyze** task.
2. Locate and select the desired folder and experimental file.
3. Press the **Open** button to load the experimental file.
4. The application will directly open the Analysis section.

Most recently used experimental files are provided within the dropdown button of the **Analyze** button.

4.2. SMART Main Window

Once the new experiment is initiated, the main window of SMART is shown with the following elements:

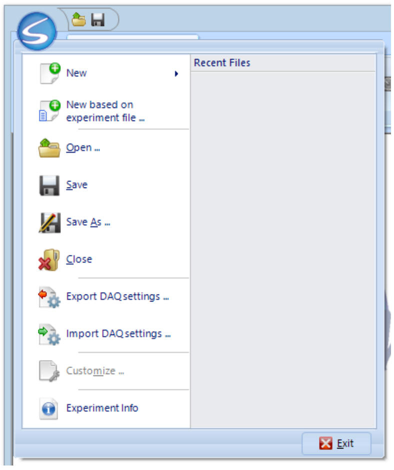


4.2.1. Title Bar

The title bar shows the name and version of the application and the name of the experimental file open. As no experimental file has been opened, "Not Saved" is shown. The asterisk "*" denotes that the experimental file has been modified and not saved so far.

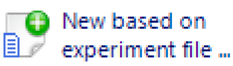
4.2.2. Main Menu

The main menu is shown when the "S" button located at the top left corner of the window is pressed.



The main menu contains the options to:

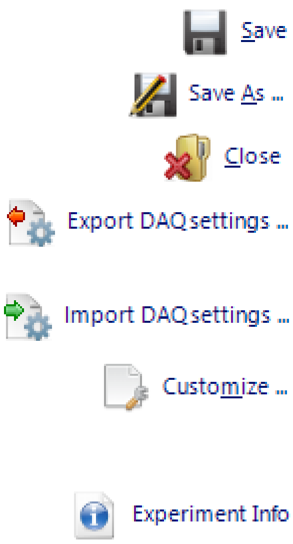
- Start a **new** experiment: in a similar way as already explained in 4.1.1 but using a dropdown menu to choose the experimental module-



- Start a new experiment based on the settings of an existing experiment as explained in 4.1.1.1.

- **Open** a previously saved experiment: as explained in 4.1.2. In addition, the

"Recent Files" section gives you a shortcut to the experimental files most recently used.



- **Save** your experiment under the same experimental file name.
- Save your experiment under a different experimental file name (**Save as**).
- **Close** the experiment.
- **Export** all the settings required for data acquisition to an external file. More information in chapter 4.2.3.
- **Import** all the settings required for data acquisition from an external file. More information in chapter 4.2.3.
- Convert an experiment of a specific experimental module into a **Customized** experiment as explained in 4.3.1
- Access the **Experiment Info** window to review and/or edit the information.

4.2.3. Importing and Exporting Data Acquistion Settings

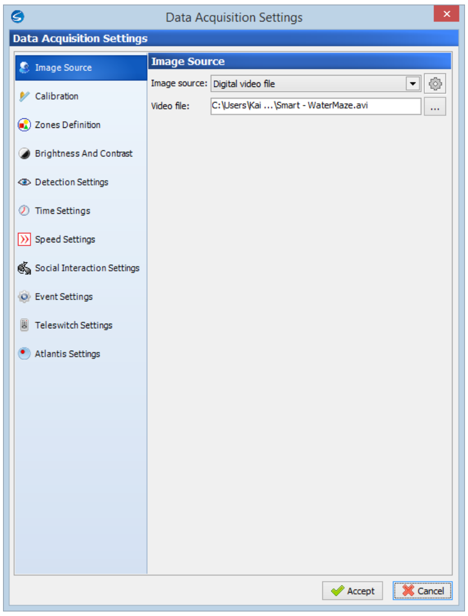
All settings required to acquire data can be exported and imported to and from an external DAQ Settings file (.smq). The settings stored within a DAQ Settings file are:

- Image Source (chapter 5)
- Calibration (chapter 6)
- Zones Definition (chapter 7)
- Brightness and Contrast for each Arena (chapter 8.1)
- Detection Settings for each Arena (chapter 8)
- Time Settings for each Arena (chapter 9)
- Speed Settings for each Arena (chapter 0)
- TriWise Settings for each Arena (chapter 13.3.1.2)
- Activity Settings for each Arena (chapter 0)
- Social Interaction Settings for each Arena (chapter 0)
- Event Settings (chapter 12.3)
- Teleswitch Settings (chapter 12.2)
- Atlantis Settings for each Arena (chapter 12.4)

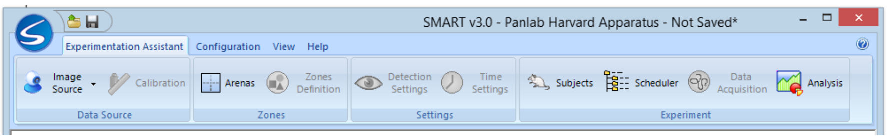
To export the current settings of the experiment, select the option **Export DAQ settings** from the main menu of the main form. A standard dialog will be shown to choose the location and name of the file to be exported. By default, the dialog will show the folder configured as **Configuration files** in the **Path Settings** panel described in chapter 12.1.

To import a settings file into the current experiment, select the option **Import DAQ settings** from the main menu of the main form. A standard dialog will be shown to choose the file to be imported. By default, the dialog will show the folder configured as **Configuration files** in the **Path Settings** panel described in chapter 12.1.

Once a file is selected for importation, the **Data Acquisitions Settings** panel will be shown. The **Data Acquisitions Settings** panel allows the reviewing and edition of the settings before they are imported into the experiment.

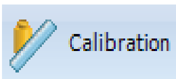
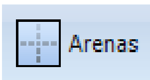


4.2.4. Experimentation assistant bar



The **Experimentation Assistant** bar has been designed to give you a quick way to access the main operations. Each button in the bar corresponds to a task within the typical experimentation process.

This bar is designed in a way that only the currently allowed tasks are active. The main tasks and the suggested order to be executed are the following:

	To specify the source of the video sequences to process.
	To define the transformation rule for a correct distances measurement.
	To define the arenas used in the experiment (Only available with the SMART-MA extension).

Zones Definition	To determine the regions of interest (zones) in the working area.
Detection Settings	To adjust the parameters of detection process.
Time Settings	To set the time conditions of the trials.
Subjects	To manage the experimentation subjects database.
Scheduler	To define the experimentation plan (phases, sessions and trials).
Data Acquisition	To execute the scheduled trials and acquire the data.
Analysis	To generate analysis reports of the finished trials.

4.3. Modules and extensions

As already explained in the chapter 1.1, SMART is designed to adapt its functionalities to the licensed modules and extensions allowing users the interface to perform the experiments they need.

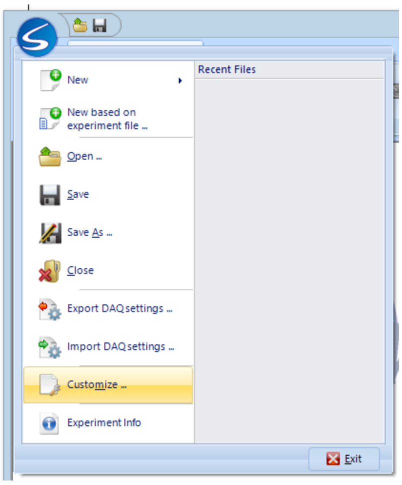
This User's Manual is intended to cover all the modules and extensions available. Some of the explanations given do not apply to every installation. Users should review only those that correspond to the modules and extensions that are included with their respective license. To facilitate the manual reading and also note specific advantages you would get if you extend your installation with additional modules or extensions, special text boxes similar to the next one will be used:

SMART-MA

This is a sample of text box that would explain the particular functionality and advantages provided only to users licensing the SMART-MA (Multiple Arena) extension.

Additionally, chapter 15 and 16 explains in detail the specific tools, procedures and calculations related to each of the experimental modules available. Chapter 17 summarizes all the functionalities and advantages provided by all the extensions available.

4.3.1. Customizing an experimental file



SMART-CS

SMART-CS users have the ability to customize an experimental file created under a specific experimental module. In this way, the ease of use and efficiency of the experimental module is combined with the powerful and flexibility of the "Customized" extension.

For example, the "Open Field" module can be used to create an experiment and define the standard zones very quickly. Then, the "Customized" extension can be applied to define additional associations or analysis reports.

In order to customize an experimental file:

1. Open the experimental file as usual.
2. Select the **Customize** option in the SMART main menu.

4.3.2. Extending your software

SMART modules and extensions can be purchased and activated as scientific needs expand. Please refer to the chapter 18.3 for more details on how to expand an existing license.

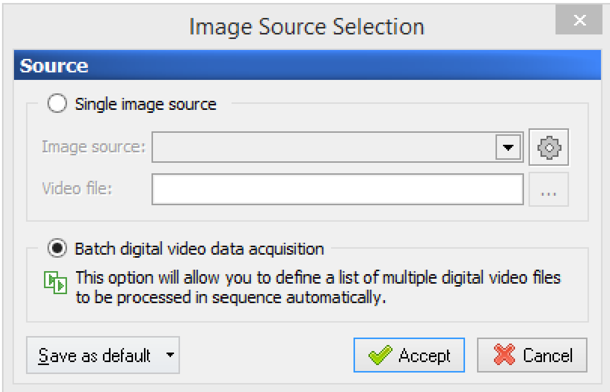
5. Image source

The first step to be done before starting the experiment is to select the image source. It is possible to select a recorded digital video file or use a live image source that provides images in real time.

To define an image source, press the **Image Source** button in the **Experimentation Assistant** bar.

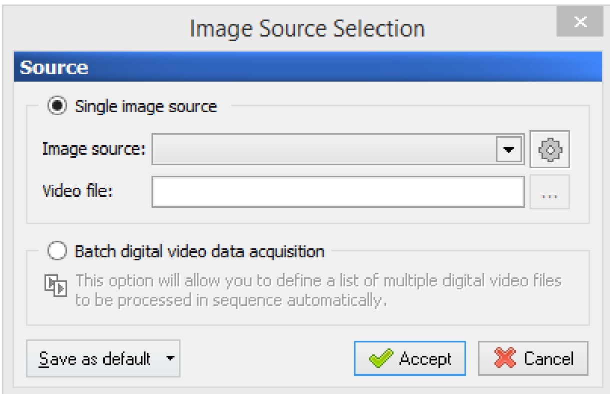
SMART provides the option to work with a single image source (either a live image source or recorded digital video files) or to work with a defined a list of digital video files to be processed in sequence automatically.

To work with a defined a list of digital video files, select the option **Batch digital video data acquisition** and press the **Accept** button:



This will activate the batch digital video acquisition system. A detailed explanation about how to use this system can be found in chapter 13.8.

To work with a single image source, complete the following steps:

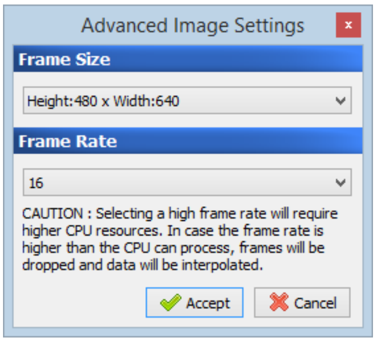


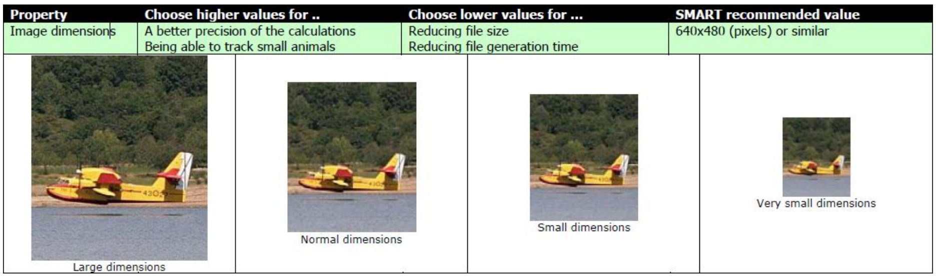
1. Select the option **Single image source**.
2. Select the type of the source in the **Image source** drop-down-list. The **Image source** list contains one element for each available (and supported) image

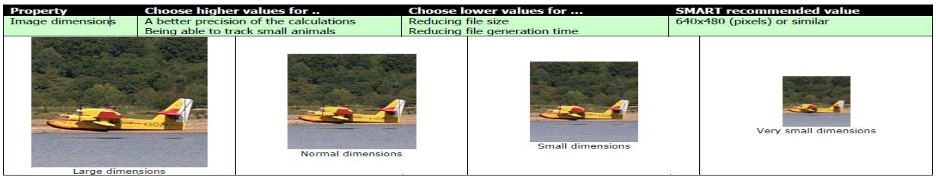
acquisition device. Please note that corresponding drivers and related software must be installed for it to be recognized.

3. If "Digital video file" option is selected, select the video file name and location by means of the button associated to the field **Video file**.

4. If a life image source is selected (as a webcam or any other live image source), then the advanced settings button will be enabled. Through this button you may access the advanced configuration panel of the selected image source device.







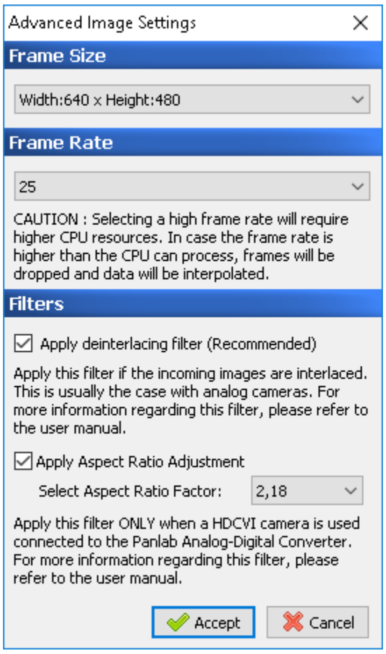
The advanced configuration panel will allow you to select the frame size and frame rate (in frames per second) to be provided by the selected image source device. Depending on the device to be configured, different frame sizes and frame rates are available. Choosing the frame size and frame rate adequately will optimize the tracking process.

Please be advised that not all image sources provide the possibility to specify different frame sizes. In that case the panel will not show the frame size section.

In many image source devices choosing a bigger image size will result in a lower frame rate. Even if a higher frame rate is selected, the frame rate is always limited by the performance of the image source and the computer system in which it is running. This may cause the tracking and/or video recording to be performed with a lower frame rate than the one configured.

TIS Digital Cameras have the binning disabled. Thus, changing the resolution from 1280x960 to 640x480 will not reduce the frame size but will just reduce the region of interest.

In case the selected device is a CONVANAUSB, then the advanced settings button will provide access to an advanced configuration panel specific for the CONVANAUSB devices. This panel allows to additionally activate two filters: the Deinterlace Filter and the Aspect Ratio Adjustment.



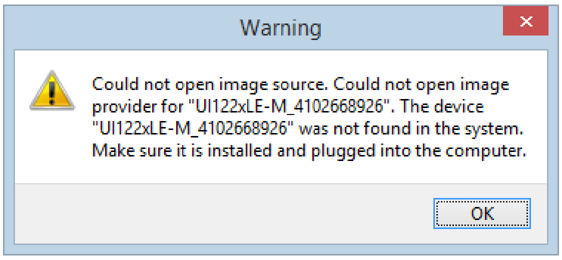
For more information about video interlacing, please refer to chapter 3.2.4 of this user manual.

The Aspect Ratio Adjustment should be applied only when the CONVANAUSB is used to connect a HDCVI camera, due to there is a light distortion of the image, which stretches vertically. Review the document “User’s Quick Guide_HDCVI Cameras” provided with the camera for additional information about this setting.

These filters require the installation of FFDSHOW codec. The FFDSHOW installer is automatically launched when SMART is installed, and no action is required by the user. In case a manual installation is required, please follow steps described in chapter 2.3.2.3 to install them.

5. Once an image source has been selected and configured, press the **Accept** button to select and load the image source. The selected image source as well as all established settings will be stored in the current experiment file.

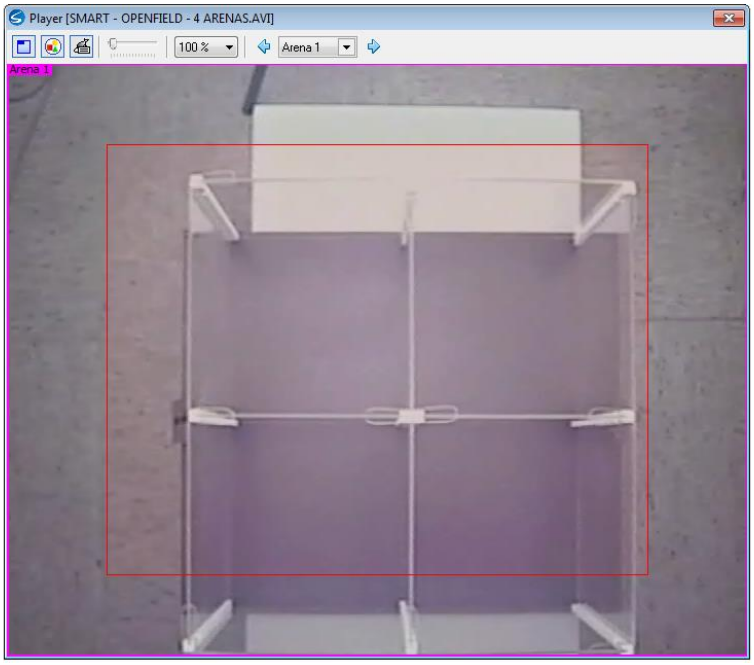
When an experiment file is opened, SMART automatically will try to connect the image source used. If this is not possible (because the device is not available yet), SMART opens the experiment and the following message:



Please refer to the chapter 2.2.3 for more details on image source selection and digital video processing.

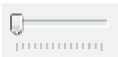
5.1. The Player Panel

Once an image source is selected and correctly loaded, the **Player** panel is shown.



The **Player** panel visualizes the acquired image, zones and arenas of the selected zone definition and allows for them to be manipulated as desired. Please refer to chapter 7 for more details on zone definition configuration.

Right clicking over the Player panel enables the zoom and zones visualization options. These and other options are also available through the tool buttons located at the top bar of the panel:

-  Shows or hides the tag of the arenas
-  Shows or hides the zones
-  Shows or hides the subject tag shown during the detection test and acquisition process
-  Adjusts the opacity of the zones
- 

  Adjusts the zoom

SMART-MA

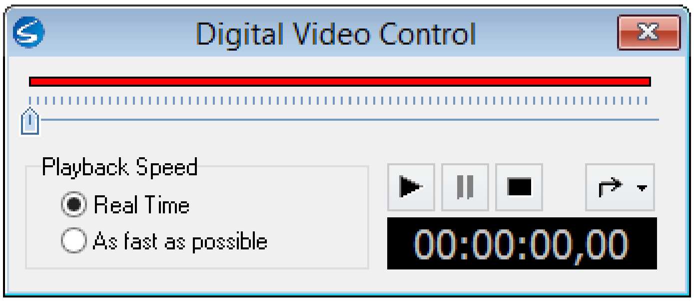
SMART-MA users are provided with a tool called "Arena Selector". This tool is available in a variety of windows along the application and allows you to identify which arena is currently selected and also to select a different one by using the arrow buttons or the dropdown list.

The Arena selector facilitates the task of configuring and managing each arena independently.

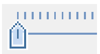
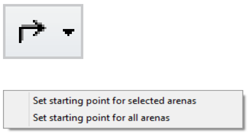
More details on the specific advantages of the arena selector will be explained with each window.

5.2. The Digital Video Control panel

If a digital video file was selected as image source, the **Digital Video Control** panel is also shown to facilitate the reproduction of the video.



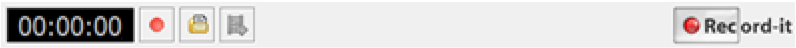
Digital Video Control panel has the following elements:

	To start, pause and stop the video reproduction.
	To seek to a specific point of the video.
	To set the starting point of the trial. In case the SMART-MA extension is available, a drop-down menu is available to apply the starting point only to the currently selected arenas or to all defined arenas.
	To visualize the time settings (latency, acquisition and delay time) of the current trial.
	To visualize the current position within the video. Please note that this time can be different of that of the trial time shown in the **Trial Time Control** panel during data acquisition.
	To select the video processing speed (normal or fast mode).

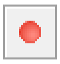
If the subject is not detected when the trial is started, the time settings bars will not match with the trial execution. Please make sure to set the starting point so that the subject is properly detected when the trial starts.

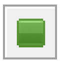
5.3. Recording digital video files within SMART

When a live image source is selected, the **Player** panel provides you with an embedded module of RECORD-IT! for easily recording the image coming from the selected camera.



The RECORD-IT! toolbar is located at the bottom side of the **Player** panel and provides the following tools:

 To start recording the video.

 To stop recording the video.

 To open the folder in which the video files are stored.

 To open the last digital video file recorded for tracking.

The video files recorded are automatically saved into the **Video files** folder configured in the **Path Settings** panel. The name of the digital video file recorded is composed by the name of the experiment file followed by the starting date and time in the standard format yyyymmdd_hhmmss.

Please refer to the chapter 12.1 for more details on how to configure the default file paths of your experiment.

Recorded digital video files are compressed using the standard XviD codec so it must be installed previously in your computer. The XviD codec is included within the SMART installation software so please refer to the chapter 2.3.2.2 for more details on how to install this specific module properly.

If the digital video file recorded will be used later for a data acquisition session, please remember the previous considerations regarding to recording digital video files described in the chapter 3.2.5.

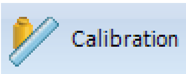
6. Calibration

The calibration process enables SMART to be informed of the actual dimensions of the experimental area in order to obtain reliable values for distances and speeds.

Digital images are formed by a group of pixels arranged in a rectangular matrix which dimensions depend on the image acquisition device (webcam, digital camera, etc.). The dimensions of that matrix are commonly called “resolution of the image”. For example, a typical webcam provides an image with a resolution of 640 x 480 pixels, that is, the pixels of each frame are arranged in a rectangular matrix which dimensions are 640 and 480 pixels respectively.

SMART starts all its calculations (speed, status, etc.) by measuring distances in pixel units and, through the calibration process, it is transformed into real units distances (centimeters or inches).

In order to improve the precision of such calculations, use a higher resolution (and, if possible, an object with higher dimensions). However, increasing the resolution requires a greater computation to process each frame.



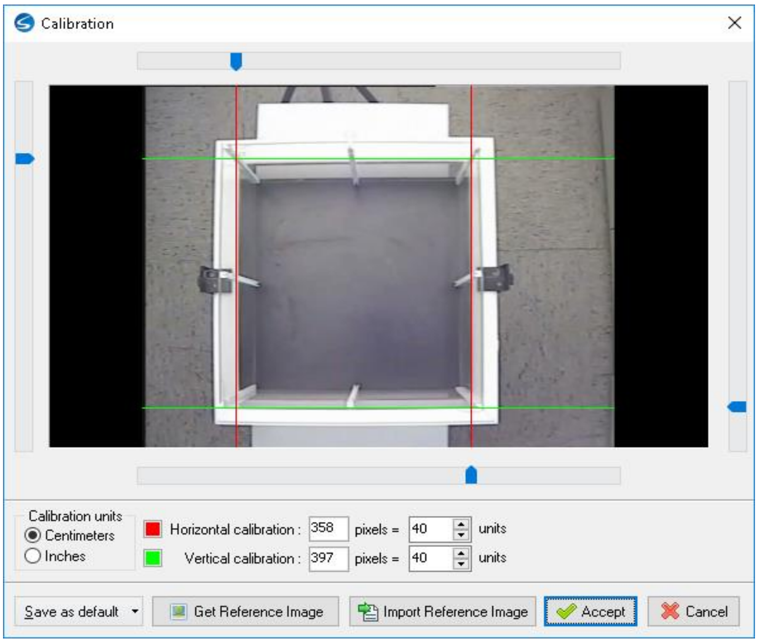
1. Press the **Calibration** button in the **Experimentation Assistant** bar.

   If no calibration has been performed before, the current frame of the image source is used as reference image to calibrate. If the calibration has been performed before, the previously used reference image is shown.

   Use the button 

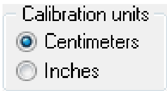
 to refresh the reference image from the currently opened image source. Use the button 

 to select the reference image from an external file. The reference image is shown with overlaid vertical and horizontal axes.

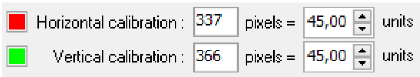


2. Choose an object of the scenery whose dimensions will be used as reference (for example: the area delimited by the distance between the base of the walls of the experimental area). More precise calibration is obtained if the selected object matches with the floor of the experimental area as that is the space in which the animal will be tracked.

3. Drag the horizontal (,) and vertical (,) markers located at the borders of the calibration image to fit your reference object into the calibration lines.



4. In the “Calibration units” box, choose “Centimeters” or “Inches” as unit of length.



5. Introduce the horizontal and vertical dimensions of your reference object **into the fields “Horizontal calibration” and “Vertical calibration”.**

6. Press the **Save as default** button whether you want this configuration to be proposed by default in any new created experimental file.

7. Press **Accept** button to apply the changes.

Calibration is stored into each trial during data acquisition to be used during the analysis process. This means that changing calibration will only affect the trials to be acquired and not the previously acquired trials. It is possible to change the calibration of registered tracks in case the calibration used during data acquisition was incorrect, however it is recommended, if possible, to discard and acquire the trial again as some detection processes (as TriWise) use the calibration to provide a more reliable tracking. More information about recalibrating trials once acquisition is finalized can be found in chapter 11.2.8.

7. Zones definition

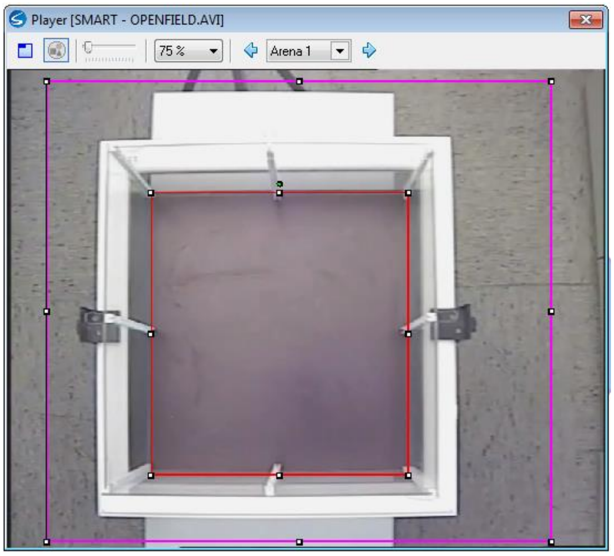
7.1. Arena & zones concept

Zones definition is the mechanism allowing you to determine the special regions that should be considered in the calculations of SMART. Examples of such calculations are:

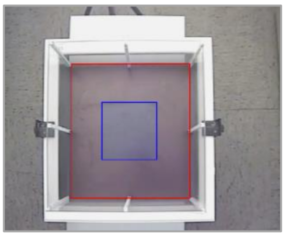
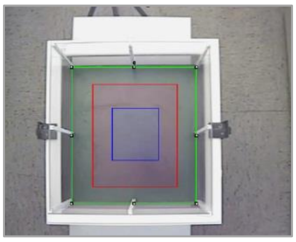
- Transitions count (number of transitions detected from one zone to a different zone).
- Permanence time and percentage (time or percentage of the whole time spent in each zone).
- Distance travelled (length of the path travelled by the subject in each zone).

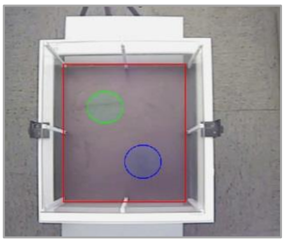
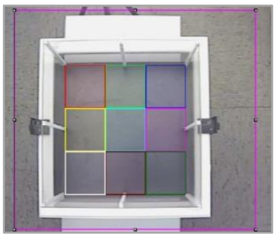
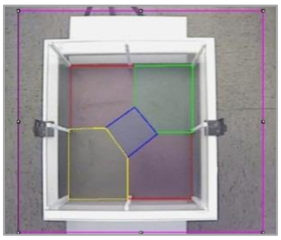
Each zone definition is defined by an experiment workspace (arena) and zones.

The physical space in which experimental trials are carried out is called an "arena". Every experiment has at least 1 arena defined which is shown in the Player panel with a pink line (see image below) and the label "Tracking area" or "Arena 1", depending on whether the SMART-MA extension is licensed or not. Each arena contains a zone or a group of zones that will be used for calculations (see red line in the image below).



An infinite number of different zones definitions can be defined and stored. The zone definitions can be then used indistinctly for data acquisition (tracking) and analysis.

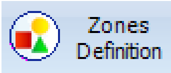




Etc.

SMART-MA

If your system is provided with the SMART-MA (Multiple-Arena) extension, the tracking process can be carried out in several arenas at the same time, increasing the productivity of the experiments.

7.2. The zones editor tool

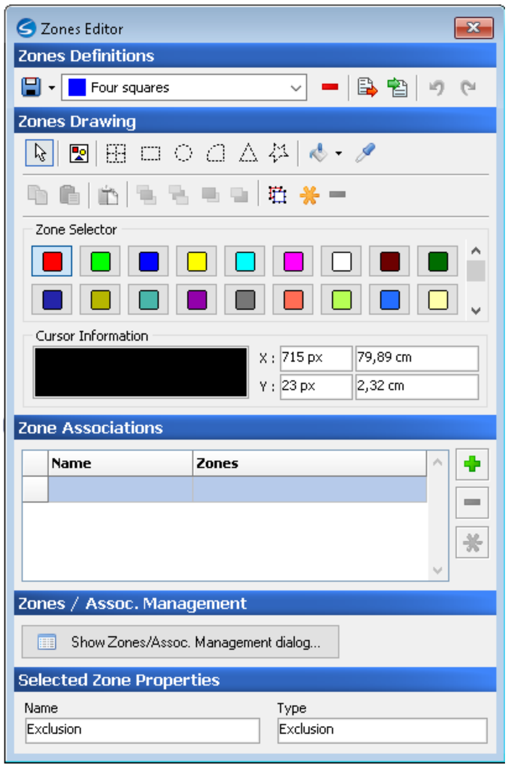


To open the zone editor tool, press the **Zones Definition** button in the **Experimentation Assistant** bar.

Different Zone definition capabilities are provided in the zone editor tool depending on the purchased SMART experimental modules and extensions.

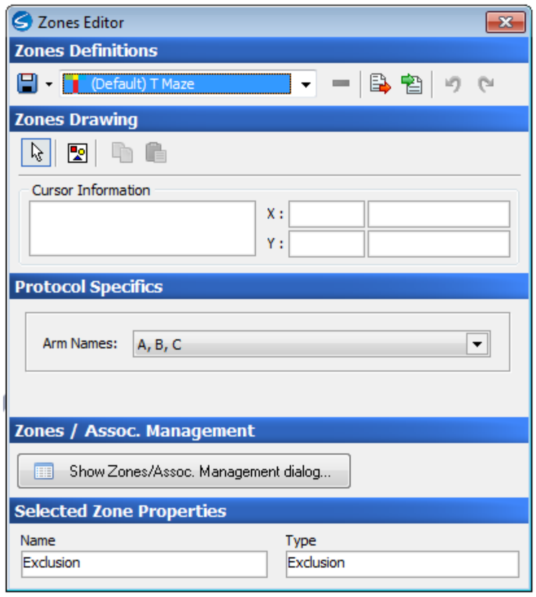
SMART-CS experimental module is provided with a flexible Zone Definition tool. The arenas and zones are freely editable. The user can decide:

- The number of arenas contained in each Zone definition (needs SMART-MA)
- the number of zones contained in each arena,
- their shape of the zones,
- name and properties.
- Associations between zones are also freely editable.

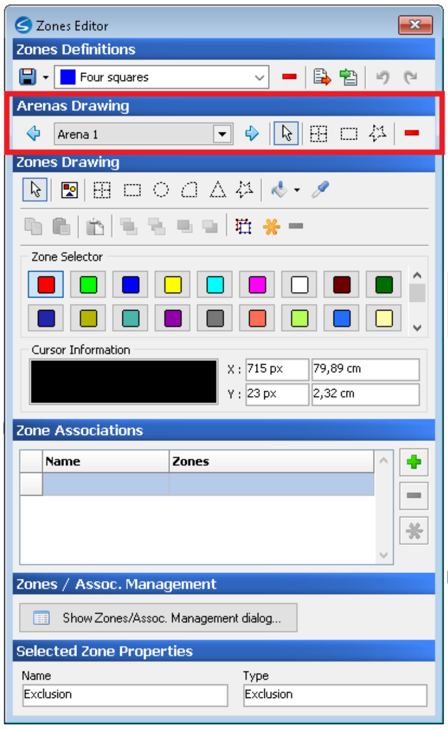


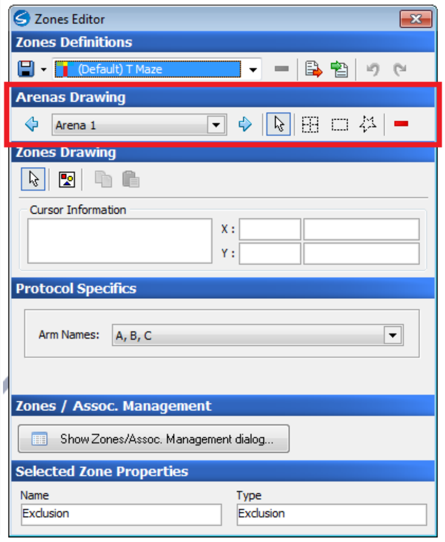
SMART-OF, PM, WM, CPP, TY, FST; SI… experiment-targeted modules are provided with a list of already defined zone definitions directly related with the purposed of the purchased experiment and that cannot be changed by the user. This makes the modules much more straightforward to use, the user has just to:

- The number of arenas contained in each Zone definition (needs SMART-MA)
- choose the zone definition to be applied from the provided list
- adapt the shape of the zone to his own experimental mazes/box or chamber.



SMART-MA extension can be used as an extension for both SMART-CS and SMART experiment-targeted modules. This extension allows carrying out tracking process simultaneously in several arenas. With this extension, the user can freely define more than one arena in which the available zones provided by the experimental module can be applied.





7.2.1. Zones definitions management

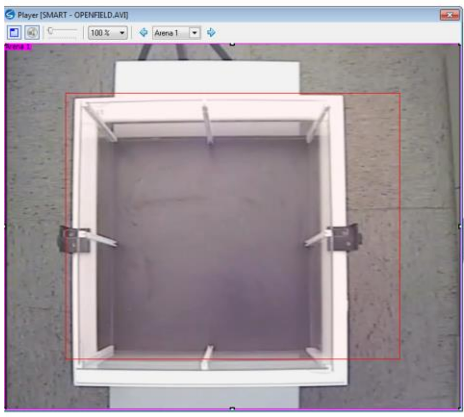
Several **Zones definitions** can be created in the same experimental file and can be chosen for data acquisition and analysis.

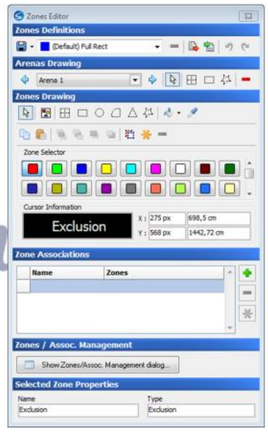
7.2.1.1. By-defaul zone definition

When creating a new experiment, the player is already associated with a zones definition selected by Default. The zone definition selected by-default depends of the SMART experimental module purchased.

SMART-CS

In the classical SMART-CS experimental module, a "Full Rect" zone definition is provided and selected by default. This zone definition contains 1 rectangular arena including 1 rectangular zone.





SMART-OF, PM, WM, CPP, TY, FST, SI...

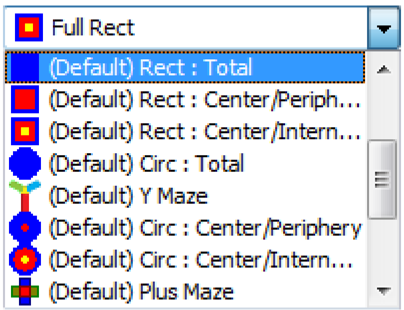
In the specific SMART experimental module, several zone definitions are provided and selected by default and can be visualized through the available list in the Zone definition section. See the list of the zone template in the chapter dedicated to each SMART experimental module. Here the example of the SMART-WM module.

7.2.1.2. Saving new zones definitions

Changes done in a base (default) zones definition should be stored with a different name. To do this, follow the next steps:

1. Press the **Save** button located in the **Zones Definitions** section of the panel.
2. Enter the name of the new zones definition and press **Ok** button.

New zones definitions are saved within the experiment file and automatically included in the list of zones definition.



Created zones definitions may be deleted using the button in the **Zones Definitions** section. Default definitions cannot be deleted.

7.2.1.3. Exporting and importing zones definitions

All the zones definitions within your experimental file can be exported and stored into external files. This operation is very useful to keep a backup of work done or to share within a different experimental file.

In order to **export** the selected zones definition:

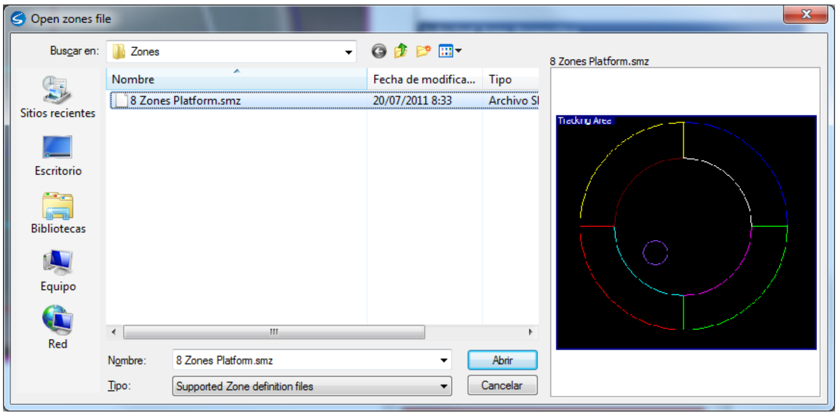
1. Press the **Export** button located in the **Zones Definitions** section of the panel.
2. Enter the name of the exported zones definition file and press the **Save** button.

Exported zones definition files are stored by default within the "Zones" folder configured and with the extension SMZ (**SM**art **Z**one). Please refer to the chapter 12.1 for more details on how to configure the default destination folders.

Exported zones definition files can be imported later into the same or different experimental file whenever both experimental files share the same experimental module.

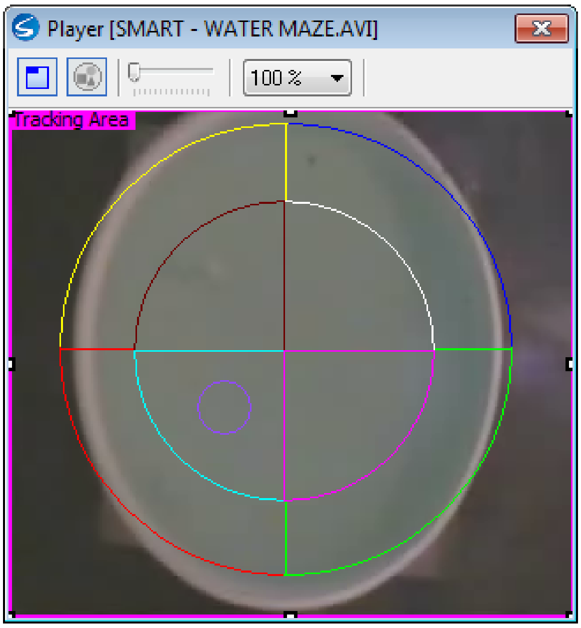
To import a zones definition file:

1. Press the **Import** button located in the **Zones Definitions** section of the panel.
2. Select the zones definition file to import. A preview of the zones definition is shown in the right side of the window.



3. Press the **Open** button to import the zones definition into your experimental file.

Imported zones definition is automatically applied to the experiment and is now available within the list of zones definitions.



SMART 3.0 or later can import zones definitions exported with SMART JUNIOR 1.0. However, zones definition files generated with previous versions of SMART (2.5 or before, *.zne and *.zon) cannot be imported within version 3.0 or later, nor vice versa.

7.2.2. Arena management

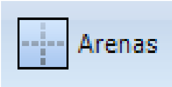
All SMART experimental modules are provided with 1 arena and 1 included zone given by default.

SMAR-MA

The possibility to create new arenas is only possible when the SMART MA extension has been purchased.

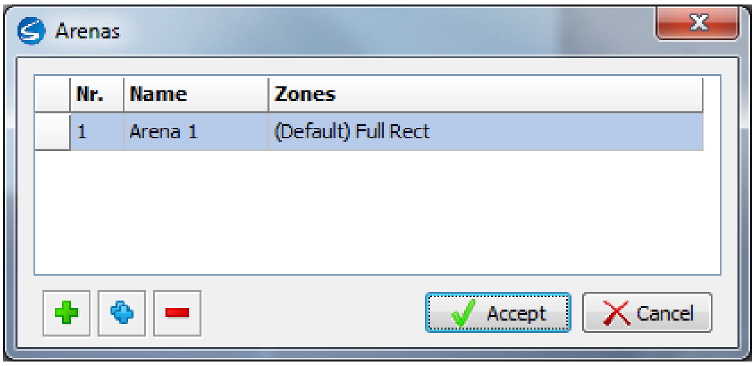
The rest of this chapter only applies to SMART-MA users.

Two steps are then needed to create new arenas: create the arenas and edit them.



7.2.2.1. Create new arenas

SMART-MA users are provided with an exclusive button "Arenas" located in the **Experimentation Assistant** bar. This button gives access to the arena definition tool:



The "Arenas" window shows the arenas that are currently defined in the experiment. To add one more arena, click the button . To add multiple arenas at once, click the button , then type the number of new arenas you wish to add and click **OK**. To delete arenas, first select the arenas you wish to delete from the list and then click the button . Note: Arena 1 can never be deleted.

Please note that each arena can be configured independently for the following configurations:

- Zones Definitions
- Detection Settings
- Time Settings
- Scheduler's trials
- Speed Settings

Deleting an arena deletes all related configurations, so this should be done with care. SMART has an integrated security system, ensuring that any arena that has associated trials with data or zones defined cannot be deleted. In order to delete an arena which has zones or trials, you first have to delete the zones and trials before deleting the arena.

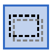
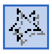
The Arenas shape and included zones are defined into the Arenas definition section of the Zone definition panel.

7.2.2.2. Multiple arenas drawing

SMART-MA users are provided with a set of tools to draw one or multiple arenas and adjust them to your boxes, mazes or apparatus in general.

These tools are provided in the **Zone Definition** panel ion the **Arenas Drawing** section.

To draw the arenas, you have the following options:

-  To draw a matrix with multiple rectangular arenas.
-  To draw a single rectangular arena.
-  To draw a single polygonal arena.

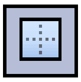
If several Arenas are drawn, please follow the next step:

- Select Arena 1 in the Arena selector
- Choose a drawing tool
- Draw the arena in the player
- Select Arena 2 in the Arena selector
- Choose a drawing tool
- Draw the arena in the player
- Repeat this process until all the Arenas have been drawn.

Arenas drawn may be modified by resizing them using the markers or by displacing them by dragging the shape from an empty space within the **Player** panel. Displacement of arenas and zones can also be achieved by using the keyboard arrows.

The shape of the arenas drawn may be deleted using the button of the **Arenas Drawing** section or by pressing the [DEL] key.

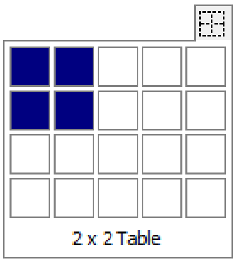
As two arenas cannot overlap, SMART will prevent drawing an arena if it overlaps other ones. In that case, the mouse pointer could will not be able to move to the overlap area.



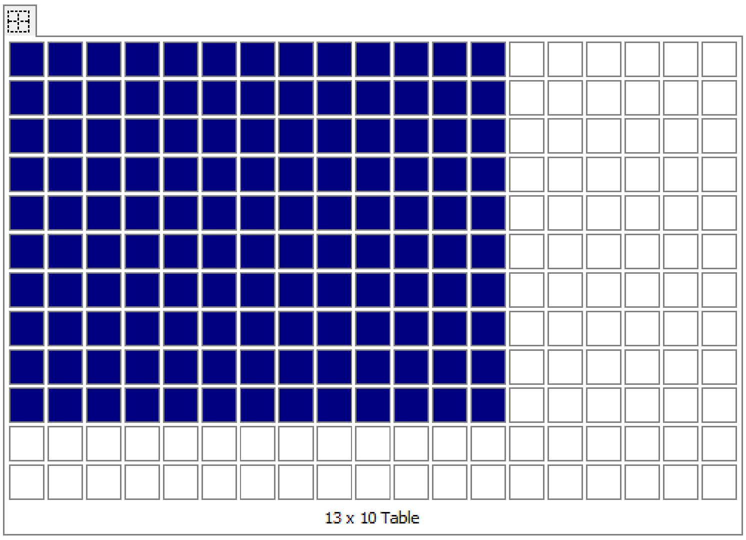
Drawing a matrix of rectangular arenas

Use this tool if you wish to draw multiple rectangular arenas at once and arrange them in a matrix. To do so, follow these steps:

1. Click the tool and select the number of rows and columns of arenas desired.

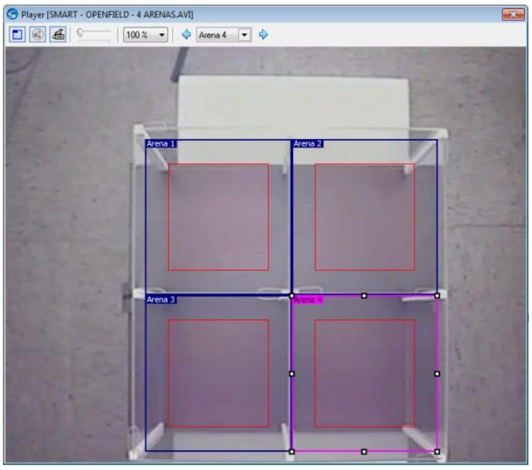


The selection can be extended to a higher number of arenas by displacing the cursor over the edges if the arena grid tool.



Even if the Draw Arena tool allows the drawing of an unlimited number of arenas, the capacity for SMART to carry out optimal data acquisition would depend on other factors such as the computer performance.

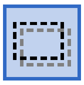
2. Draw a rectangle on the **Player** panel by dragging with the mouse from top-left to bottom-right. A matrix will be shown. If satisfied with the result, release the mouse button and the arenas will be created with the selected default zone shown inside.



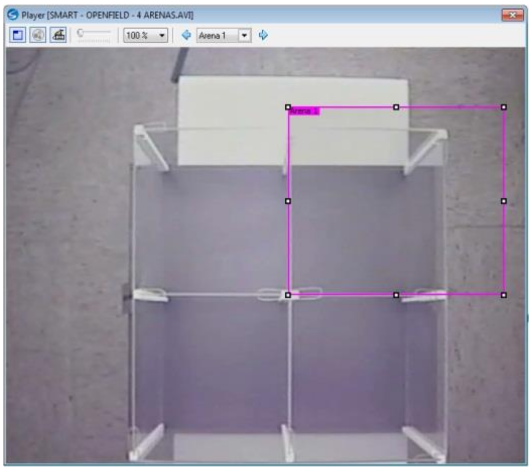
<u>Drawing a single rectangular arena</u>

Use this tool to draw a single rectangular arena. To do so, follow these steps:

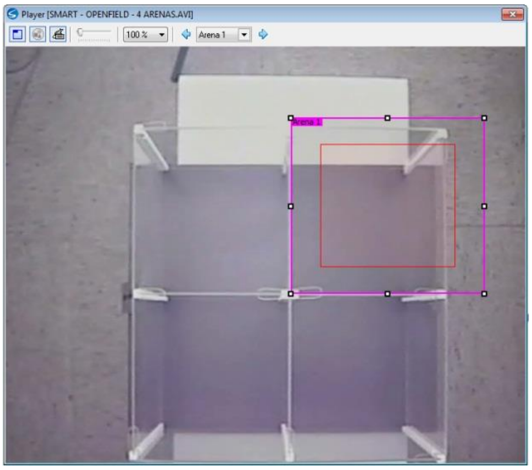
1. Select the arena to draw using the “Arena selector” tool. To create a new arena, click the  button in the **Experimentation Assistant** bar.



2. Select the rectangle tool in the **Arenas Drawing** section.
3. Draw a rectangle on the **Player** panel by dragging with the mouse from top-left to bottom-right. A preview of the arena is shown.



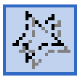
4. If you are satisfied with the result, then release the mouse button and the arena will be created and with the selected default zone shown inside.



<u>Drawing a single polygonal arena</u>

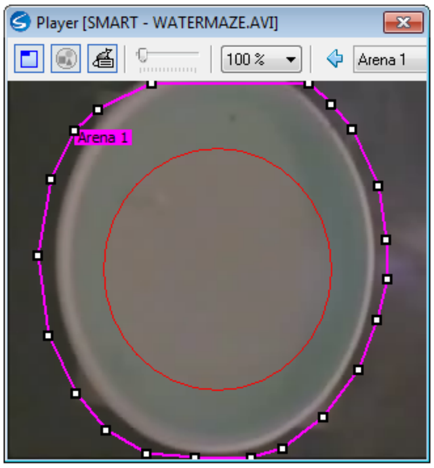
Use this tool to draw a single polygonal arena. Polygonal arenas can be drawn freely by connecting segments to fit the special shape a box, maze or apparatus in general. To do so, follow these steps:

1. Select the arena to draw using the **Arena selector** tool. To create a new arena, click the Arenas button in the **Experimentation Assistant** bar.
2. Select the polygon tool.



3. Draw the segments of the polygon where desired by clicking on the **Player** panel.

4. To finish the polygon, click near the first segment to close the shape. The cursor will change to a hand indicating that if you click there, the arena will be closed.



7.2.3. The Zone drawing section

SMART-CS

SMART-CS module enables users to freely draw, move, resize, rotate and, in general, adapt the shape of the zones to specific needs without the restrictions applied to the experimental modules.

The rest of this chapter only applies to SMART-CS users.

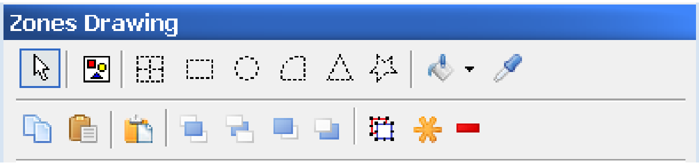
7.2.3.1. Choose a Zone color

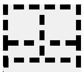
The number of zones is restricted to 255 per arena, which are represented and identified by their colors in the **Zone Selector** section.

Each zone has a color assigned to it: red is for Zone 1, green for Zone 2 and so on. To define or modify a zone, its button in the **Zone Selector** section must be activated.

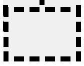
7.2.3.2. Draw Zones

A few drawing functions enable the experimenter to create a wide range of different geometric shapes. Select one on the **Zones Drawing** section and position the cursor over the **Player** panel to fix the tracing points, according to instructions given below. By default, the pointer tool is selected.

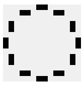




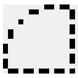
- Matrix or arenas: Use this tool to quickly draw a matrix of rectangular arenas.



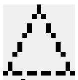
- Rectangle: Define a rectangular shape by two opposite vertexes.



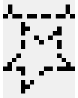
- Ellipse-Circle: Draw an elliptic shape by means of a rectangle. The sides of the rectangle will be parallel to the ellipse axis, and tangent to it, so the ellipse will be inscribed in the rectangle. If all sides are equal, then the rectangle becomes a square, and the ellipse is a circumference.



- Pie/Sector: This tool is particularly useful to define zones on a circular pool.



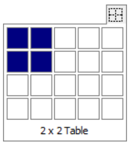
- Triangle: Define an equilateral triangle by its center and the length of one side.



- Polygon: Use this tool to draw irregular polygons. The polygon vertexes are the tracing points to be fixed.

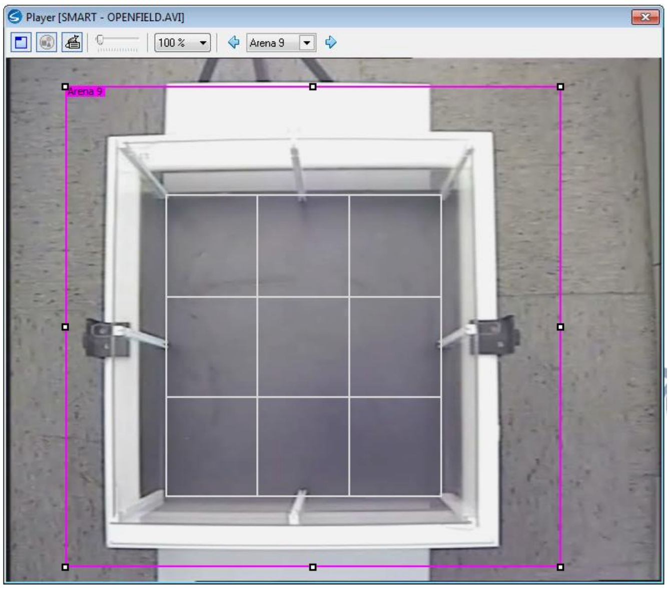
The process to draw zones using the tools mentioned above is noted here:

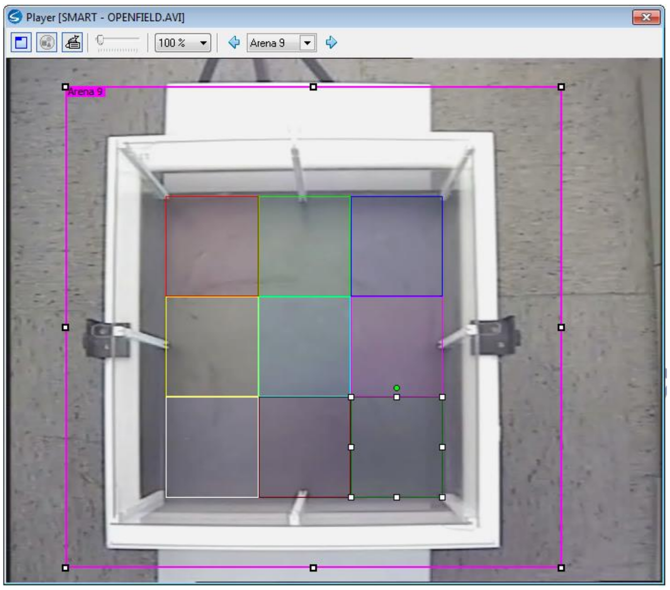
1. Select a zone number in the **Zone Selector** section.



2. Select the zone drawing tool. In the specific case of the zone matrix, the number of rows and columns to be created must be selected. The selection can be extended to a higher number of zones by displacing the cursor over the edges if the zones grid tool.

3. Press the left mouse button over the **Player** panel and, without releasing it, move the mouse pointer from left to right and from top to bottom.



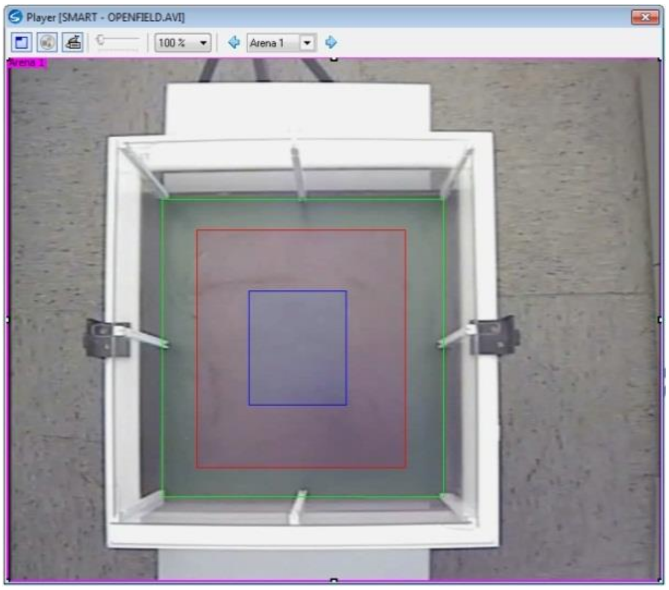


This process is specially different when a polygonal zone is being drawn. In this case, draw the segments of the polygon by clicking on the **Player** panel desired.

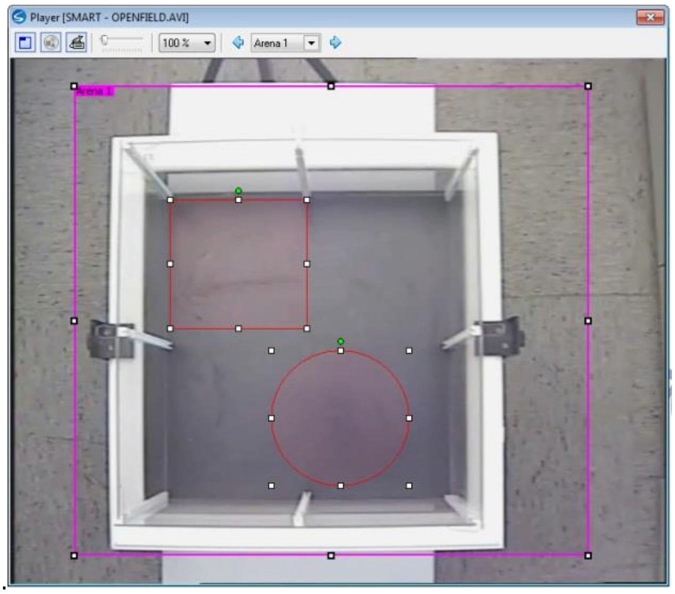
To finish the polygon, click near the first segment to close the shape. The cursor will change to a hand indicating that if you click there, the zone drawing will be closed.

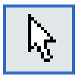
During this process, the zone shape is shown to facilitate adjusting the size. If the [ESC] key is pressed before releasing the left button of the mouse, then the zone creation is cancelled.

4. Repeat the operation until all the required zones has been drawn. (here the example of 3 zones drawn in an open-field: centre, border and internal zone).

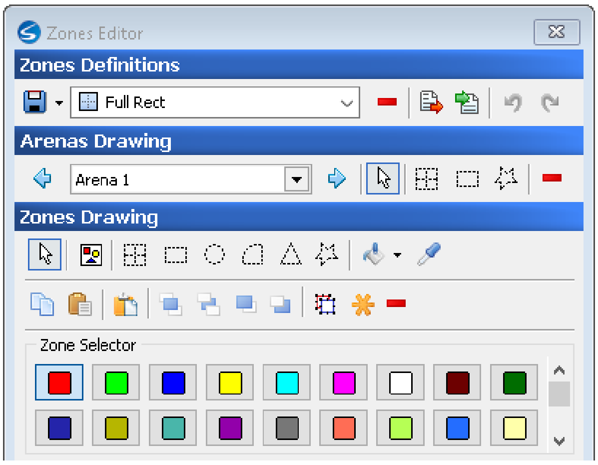


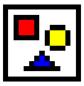
5. A single zone may be made up of two or more non-adjacent enclosures, each having its own boundary. These separate parts will be regarded as one in the analysis processes. The following is an example of two shapes that make up the zone 1





6. Close the drawing process by selecting the pointer tool again.



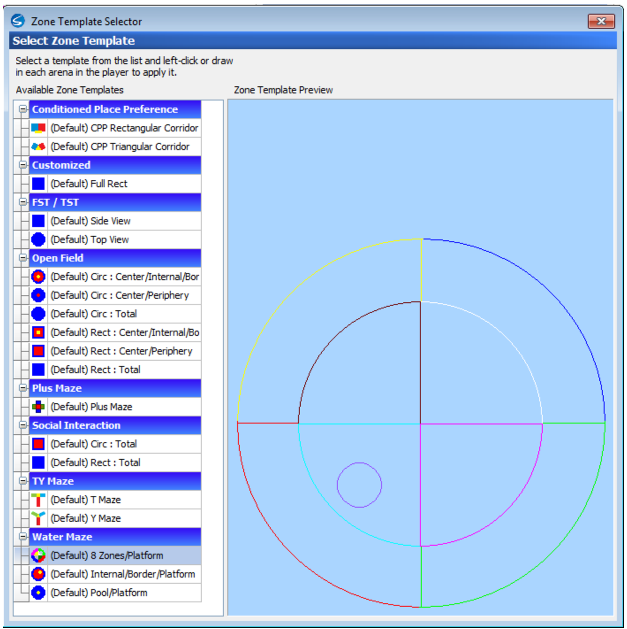


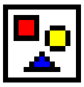
- Zone templates: Facilitate the task of drawing complex zone definitions with a single click. Each SMART experiment-targeted module licensed to the protection key provides a set of templates related to the corresponding experimental paradigm.

SMART-CS

The SMART-CS is only provided with zone templates when combined with one or several SMART experiment-targeted modules (SMART-OF, SMART-PM, SMART-FST, SMART-WM etc.…)

Here a view if the full list of zone templates provided by all the experimental modules available:



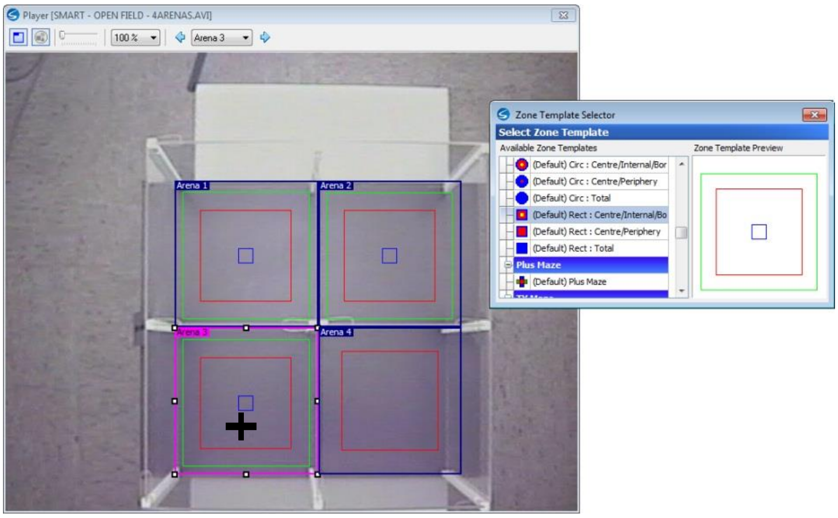


If you wish to apply a predefined template to your tracking area or to a particular arena:

1. Select the **Zones Templates** tool in the **Zones Drawing** section.

2. Select one of the templates in the **Zone Template Selector** panel. A preview of the template is shown in the right side of the panel.

3. Click over the **Player** panel in every arena you want to apply the template. The zones template will be automatically applied and adjusted to the size of the arena.



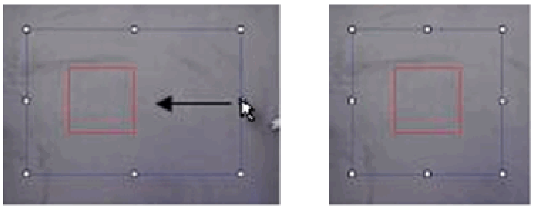
4. Close the **Zone Template Selector** panel with the X button located at the top right corner of the panel.

5. Adjust the applied template to your specific needs.

7.2.3.3. Adjusting the zones

Once a zones or template has been applied, you can adjust it by moving or resizing each zone shape. To do this, follow the next steps:

1. Select a zone shape clicking inside it in the **Player** panel. White rectangular markers will appear surrounding the selected shape.
2. Click in one of the markers and drag to **resize it**. Please note that resizing operation can be applied only to a single zone at once.



3. Click inside the zone shape and drag to **displace it**. To facilitate the displacement of all the zones at once, press the **Select all zones** button in the **Zones Drawing** section and displace the zones. The [ARROW] keys combined with the [CTRL] key facilitate a fine adjustment by doing smaller displacements of the zones.

4. **Rotate** a zone. Select the zones and drag the green circle located close to the first vertex of the shapes. All the zones will be rotated around the center of the rectangle in which the selected zones are inscribed

Depending on the selected protocol, adjusting a particular shape could imply a general adjustment in order to maintain the coherence of the whole definition. Some specific adjustments can also be done by mean of the **Protocol Specifics** section of the panel.

Use the **Undo** and **Redo** buttons to undo and redo changes made in the zones.

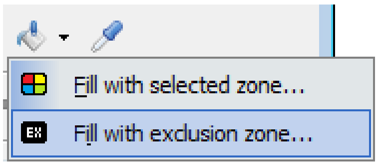
7.2.3.4. Additional tools

- Pointer: Use the pointer tool to select zones or arenas. In combination with the [SHIFT] and [CTRL] keys, multiple zones and arenas can be selected.

- Copy / Paste: Facilitates copying the zones from one arena to other. Select one arena, press the **Copy** button, select the other arena and press the **Paste** button to copy the zones. Create new arenas

- Copy / Paste Zone: Facilitates copying the zones inside the same arena. Select a zone in an arena, press the **Copy/Paste Zone** button and click in one or more positions in the same arena. Finish the paste process by selecting the pointer tool again.

- Filling: This tool changes the color of a given region. Select the desired color, place the cursor on the region and click.



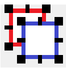
The **Filling** button provides a dropdown menu with the following options:

- Fill with the selected zone: to fill the area with the selected color.
- Fill with exclusion zone: to convert a zone to "exclusion zone" (see chapter 7.2.3.5 for a definition of an exclusion zone.

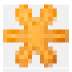
- Color / Zone Selection: Use this tool to select one existing color and zone. Place the cursor over the desired zone in the **Player** panel and click to select color and area.

- Zone layers: The zones mutually exclude each other so that a given point of the image always belongs to just one zone. As has previously noted, if there are no zones defined, every point in the image belongs to the exclusion zone.

  These tools make the selected zones (enclosures) to be moved onto the upper / lower layers, when configuring a multiple layer zones set-up.



- Select all zones: This button selects all the zones in the arena/working area to facilitate resizing, displacing or rotating all them at the same time.



- Clear all zones: Deletes all the zones in the selected arenas/working area.

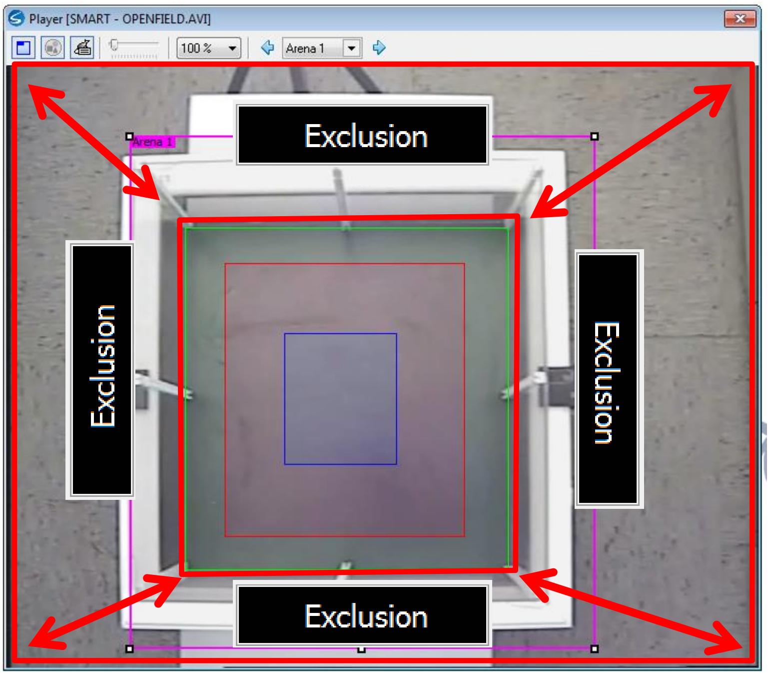
- Delete selected zones: Deletes the selected zones in the selected arenas/working area.

7.2.3.5. The exclusion zone

To define a zone as the "exclusion zone" please refer to chapter 7.2.3.4.

The "exclusion zone" is a special zone conceived as the area where no subject will ever be. SMART will not process this part of the image to save resources, and prevent interferences. The exclusion zone is a user-defined zone from which no type of data is obtained. If no zone has been defined, the exclusion zone takes the whole surface so that SMART will not "see" anything. It is the experimenter who, by drawing zones on the image, tells SMART what parts of the image are to be processed. To obtain practical data from an experiment at least one zone other than the exclusion zone must be defined.

In a general manner, any spaces out of the defined zones are automatically considered as Exclusion zone.



7.2.3.6. Using the keyboard to edit zones efficiently

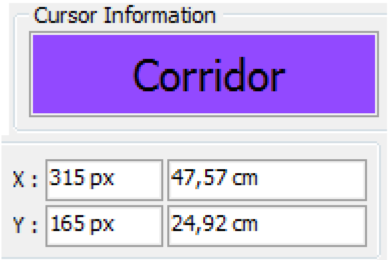
Although the mouse is the most common device to interact with the software, it is not always the most efficient. The keyboard provides a much faster way to carry out many of the operations regarding the edition of zones.

SMART Zones Editor is designed to accept the use of the keyboard to accelerate the setup.

The most useful keys and combinations are:

Key / Combination	Effect
[ARROWS]	Long displacement of the selected zones or arenas.
[CTRL] + [ARROWS]	Short displacement of the selected zones or arenas.
[CTRL] + Mouse click	Selection of multiple independent zones or arenas.
[SHIFT] + Mouse click	Selection of multiple zones or arenas in sequence.
[CTRL] + Resize	Resizes the selected zone or arena keeping its aspect ratio. Only applies to rectangular and elliptical zones.
[DEL]	Removes the selected zones or arenas.
[ESC]	Cancels of the current edition task (creation, resizing, displacement or rotation).

7.2.3.7. Cursor information



When the mouse is moved over the **Player** panel, SMART automatically updates the **Cursor Information** section of the **Zones Editor** panel showing the following information:

- The name and color of the zone where cursor is located.
- The X and Y coordinates (in pixels and in the calibration units) in which the mouse is located.

7.2.4. Create an Association of zones

SMART-CS

SMART-CS module enables you to freely define associations between the zones.

The rest of this chapter only applies to SMART-CS users. Users with experimental modules but not SMART-CS specifically licensed are provided with default associations that cannot be adjusted.

This option allows combining different zones and then obtaining a new set of combined zones.

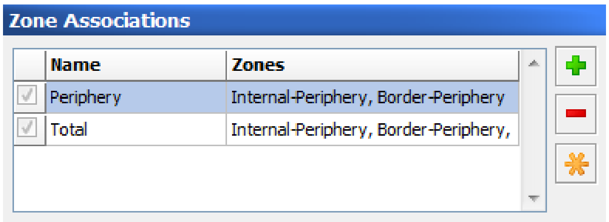
As an example, the **Border-Periphery** and **Internal-Periphery** zones of an open-field can be combined to create a new zone association defining the **Periphery** of the experimental area in a paradigm aiming to assess anxiety in rodents. All the zones can also be combined (Border-Periphery + Internal-Periphery + Center) to define a new zone referring to the **Total** experimental area.

- Select the zones you wish to associate by clicking on the zones with the left button of the mouse in combination with the [CTRL] / [SHIFT] keys. Please note that in order to create an association; at least two zones must be selected. Exclusion zone cannot take part of an association.

- Press the button located at the right side of the table in the **Zone Associations** section.

- Enter a unique name for the new association and press **Ok**.

- Repeat the operation for all the associations requested.



- Use the button to delete the association selected in the table.

- Use the button to delete all the associations in the table.

Some useful tips related to zone associations:

- Zones templates provided with experimental modules already include the standard associations, so it is not necessary to create them again.

- Double-click an association row within the **Zone Associations** section to highlight the corresponding zones in the **Player** panel.

- If a zone included in an association is deleted, it will be removed from the association as well.

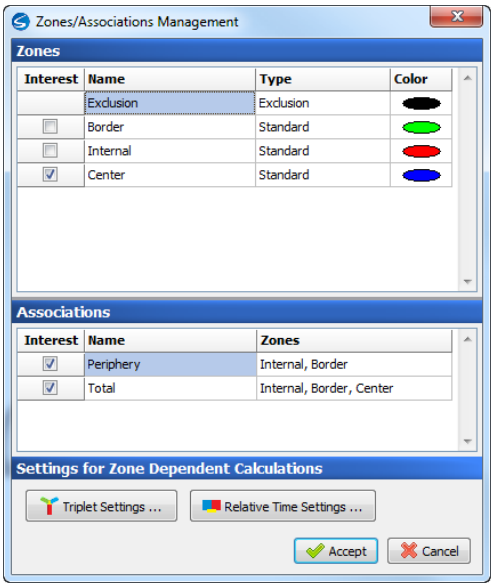
7.2.5. Zones and Associations management

SMART-CS

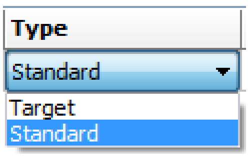
SMART-CS module enables you to freely edit names of zones and associations, properties and zone-dependent specific calculations.

In the SMART experiment targeted modules SMART-OF, PM, WM, TY, CPP, FST, SI (...), these options are only available for information visualization; their edition is disabled.

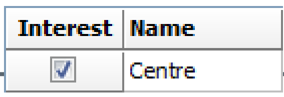
SMART-CS module enables you to freely edit the zones and associations properties. The **Show Zones/Assoc. Management dialog** button located in the **Zones/Assoc. Management** section provides a tool.



Except the exclusion zone, zone names and types (but not the color) can be edited by clicking the corresponding cells in the table. The zones are categorized in two different types:



- Standard: by default, no special features. All zones are standard by default.
- Target: will allow configuration of a special timing condition stopping the tracking process when the subject is detected in the Target zone (commonly used in water maze experiments in which it is required to stop the tracking process when the animal found the platform. In this case, the Platform zone is set as a Target zone). Several zones can be defined as Target.



The **Interest** checkbox allows you to select which zones will be considered for data visualization in the runtime panel.

Regarding zone associations, both the **Interest** checkbox and the name can be also edited in the corresponding table.

SMART-CS

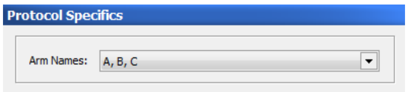
SMART-CS users are provided with two additional options to configure the evaluation process of zone dependent calculations:

- **Triplet Settings**: allows selecting which zones in the definition will be considered in the evaluation of the *alternation triplet* calculation used in T/Y mazes. Please refer to the chapter 15.3.1.3 for more information on this calculation.

- **Relative Time Settings**: allows selecting the zone which time will be proportionally distributed between all the other zones contained the current zone definition. This parameter is required to evaluate the relative time in the zones of a CPP test. Please refer to the chapter 0 for more information on this calculation.

7.2.5.1. Protocol specifics

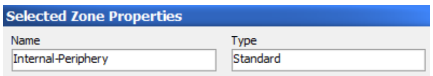
Some experimental modules are based on zones definitions that require a specific configuration to calculate the information during the data acquisition and analysis processes.



For example, SMART-TY module (T/Y Maze) requires the identification of the arms in the maze for the alternation calculation.

This configuration is provided to you through the **Protocol Specifics** section in the **Zones Editor** panel. Please refer to chapter 16 to know which specific configuration is required by each experimental module.

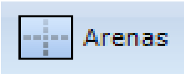
7.2.5.2. Selected zone properties



When a zone is selected in the **Player** panel, the **Selected Zone Properties** section automatically shows the name and properties that have been defined in the **Zones/Associations Management** tool.

SMART-CS

By default, zones are named as Zone 1, 2, 3, … However, SMART-CS users are able to freely edit the properties of the zones such as their names (by a more meaningful name related to the current experiment). To do so, use the **Zones/Associations Management** tool described in chapter 7.2.5.



8. Detection settings

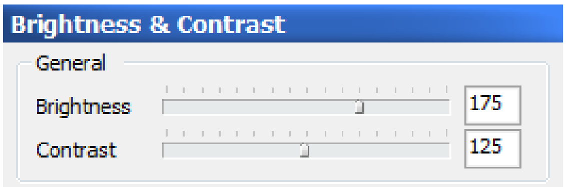
In order for SMART to precisely detect the position of the animal in the image, some detection adjustments must be set. The tracking process requires a clear and well-contrasted image.

Press the **Detection Settings** button in the **Experimentation Assistant** bar to adjust those parameters and test the tracking before starting the data acquisition sessions.

8.1. Brightness and contrast

For improving contrast, SMART includes a fine adjustment of general brightness and contrast parameters in the section **Brightness & Contrast** of the **Detection Settings** panel.

These settings can be adjusted for the whole image or for user-defined zones.



SMART has default values for each of the parameters that should be chosen for light conditions that may be regarded as "normal". However, these parameters can be modified for optimal results.

- Brightness

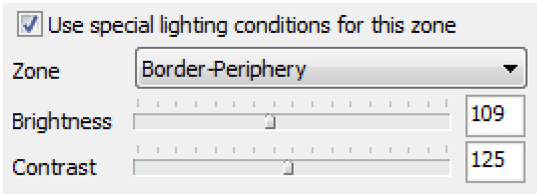
  The range varies from 0 to 255. A zero value will give a very dark image while 255 would display a very white image.

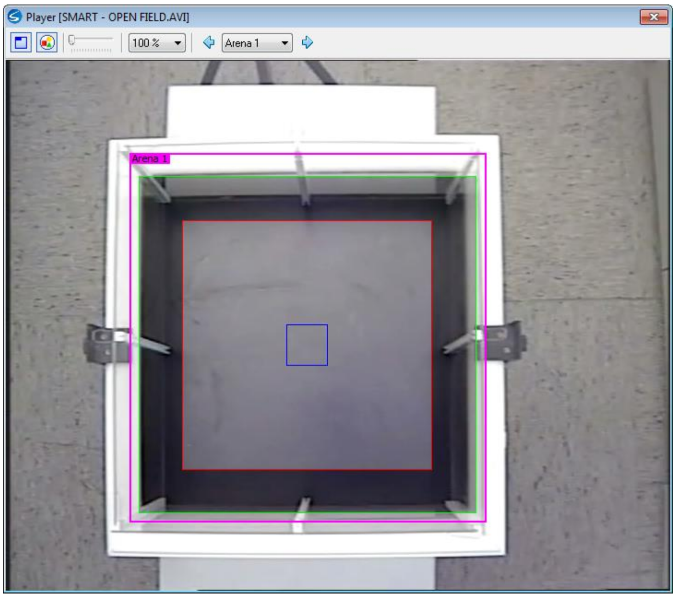
- Contrast

  Modifying this value varies image contrast. The values may be between 0 and 255 also.

8.1.1. Lighting conditions for specific zones

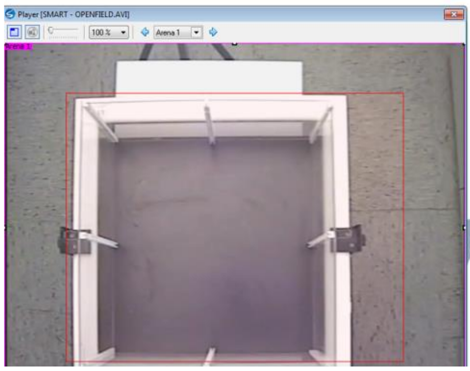
After applying general settings there could still be certain regions in the image with too much illumination or shadows. Particular lighting conditions can be established for these specific zones using the setting "**Use special lighting conditions for this zone**".

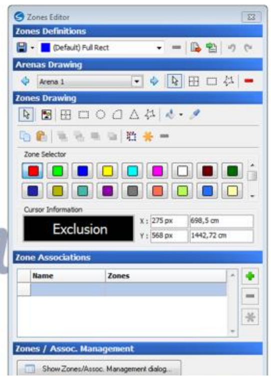




1. Check the **Use special lighting conditions for this zone** box.
2. Select the zone to which the special adjustments must be done.
3. Tune the brightness and contrast parameters.
4. Repeat steps 2 and 3 for each zone in which special adjustments are required.

SMART-MA



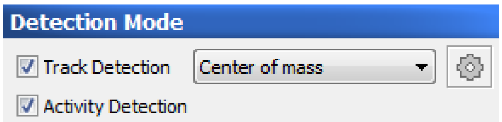


8.2. Detection modes

Six detection modes are available in SMART depending of the purchased modules and extensions:

1. **Centre-of-mass tracking detection** mode
   provided by the SMART-CS and SMART experiment-targeted (OF, PM, WM, TY and CPP) modules.
2. **Manual tracking** mode
   provided by the SMART-CS and SMART experiment-targeted (OF, PM, WM, TY and CPP) modules.
3. **3-points tracking detection (head, centre, tail)**
   provided by the SMART TW extension
4. **Color tracking detection modes**
   provided by the SMART TW extension
5. **Multiple Subject tracking detection** mode
   provided by the SMART-SI experimental module
6. **Global Activity detection** mode - provided by the SMART-GA extension

Each detection mode is selected in to the Detection mode section of the Detection settings panel.



SMART-MA

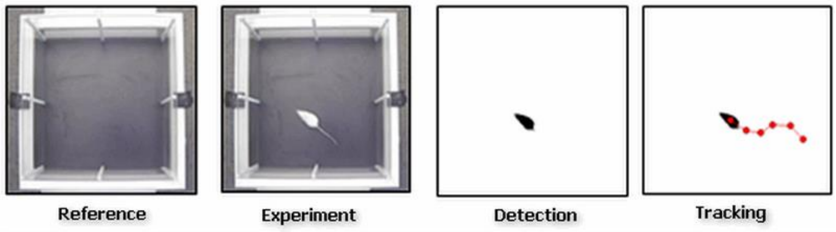
An "Arena selector" control is provided for SMART-MA users within the **Detection Settings** section to adjust the detection parameters for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely. The image will be automatically updated to reflect the new settings during the acquisition test.

In order to apply the new settings to all the arenas simultaneously, check the box **Apply to all arenas**.

8.2.1. Center of mass tracking mode

In the tracking mode, an image of the experimental area without an animal is used as reference and compared with any of the images of the experiment containing the animal. The difference between both images (Reference and Experiment images) is detected by the system and converted into pixels. The position of the animal is then calculated for each image as the mean of all the pixels detected by the system (black blot in the Animal Detection image). A track is formed by consecutive detection of the animal position along the time.



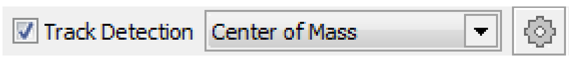
SMART uses the "Static background" technique to convert the real image of the subject in a black pixel blot: the detection image is given by the difference between the current experiment image and the background image taken as reference.

Applications of tracking the center of mass:

Tracking the center of mass is particularly recommended for the analysis of animal displacement and position allowing the calculation of a wide variety of related parameters (speed, distance, resting/slow/fast displacements, parallelism, directionality, turning angle, entries into user-defined zones, permanence time into user-defined zones, etc.…). Some example of standard applications: Morris water maze, elevated-plus maze, open-field, radial maze, locomotor response to novelty, etc.…

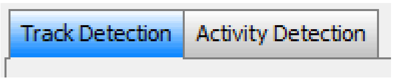
8.2.1.1. Detection mode selection

Select the **Track Detection - Center of Mass** option in the Detection mode section of the Detection Settings panel.

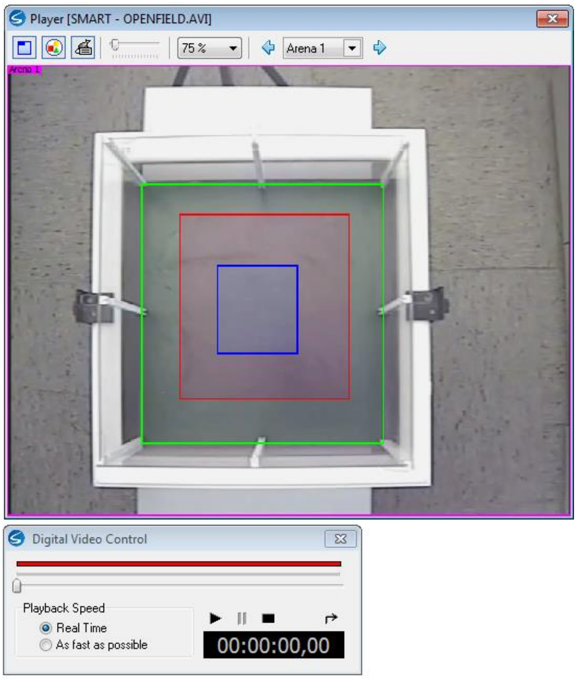


8.2.1.2. Detection test

To check the detection, the next steps must be followed:

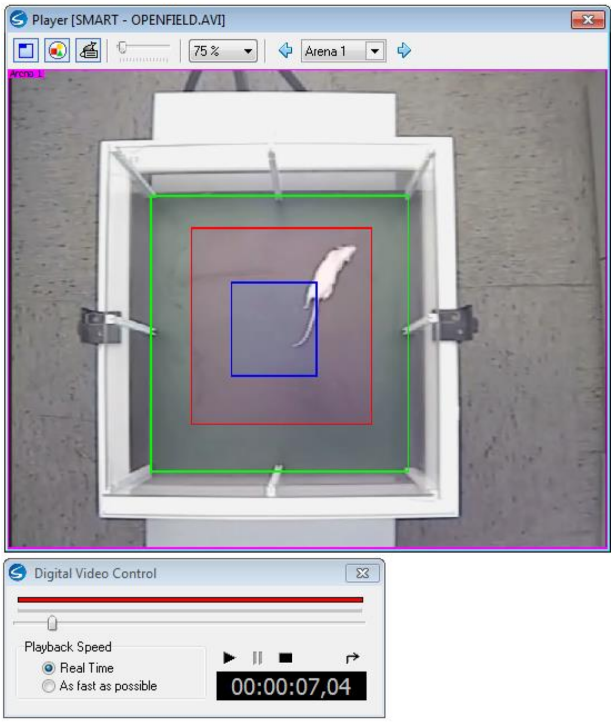


1. Select the **Track Detection** mode and the corresponding tab in the **Detection Settings** section.
2. Remove any subject from the experimental area for taking the snapshot that will be used as image of reference. The only difference between the experiment image (with animal) and the reference image (without animal), is the presence or absence of the experimental subject (the lighting and background conditions should be the same). If a video digital file is used, move the cursor of the Digital Video Control panel until a frame without animal.

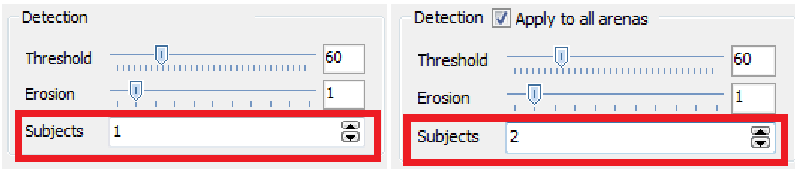


3. Press the **Snapshot** button to record the current image (frame) as the image of reference (snapshot). If the video does not contain any image of reference without animal, please refer to chapter 8.2.6 for more details on how to edit a snapshot.

4. Put a pilot subject (o object with similar color) into each arena to test the detection process. If your image source is a digital video file, use the **Digital Video Control** panel again to set a new starting point for the tracking detection test.

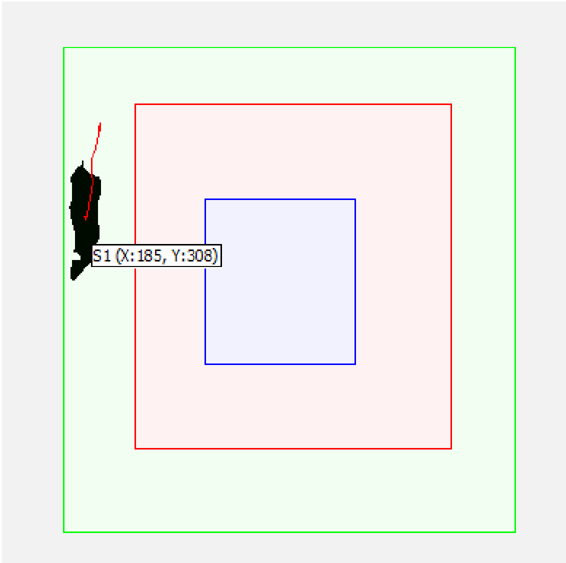
5. 

6. Set the number of Subject to be detected. Selecting more than 1 Subject is only allowed when working with the **SMART-SI** module.



The Subjets selector is the Test panel is only used during the detection testing process. This number has no effect on data acquisition. In data acquisition, the only configuration that will fix the number of subjects that will used for each trial is the number of subject that will be assigned to the trial in the Scheduler (see Chapter 11.2 for more details about the Scheduler configuration for more than 1 subject).

7. Press the **Start Test** button to verify if the detection process can identify the subject correctly. The Calibration process (see chapter 6) has to be done before starting the Test. The difference between the current image and the image of reference is converted in pixel (black dots). Detection is considered as optimal when the only black dot shown in the player is the animal. In that case, the red tracking line should closely follow all the animal displacements and a white label with the animal number and coordinates is shown.

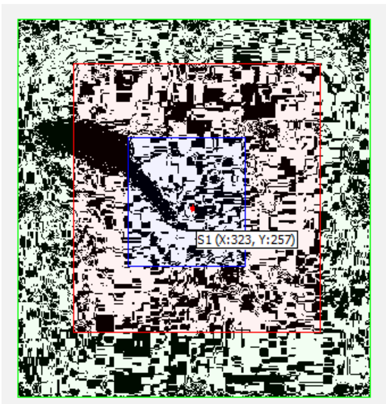


If such detection is not obtained, adjust the Threshold and Erosion parameter for optimizing the detection process.

8. Adjust **Threshold** and **Erosion** parameters to get a sharper and noise-free test image.

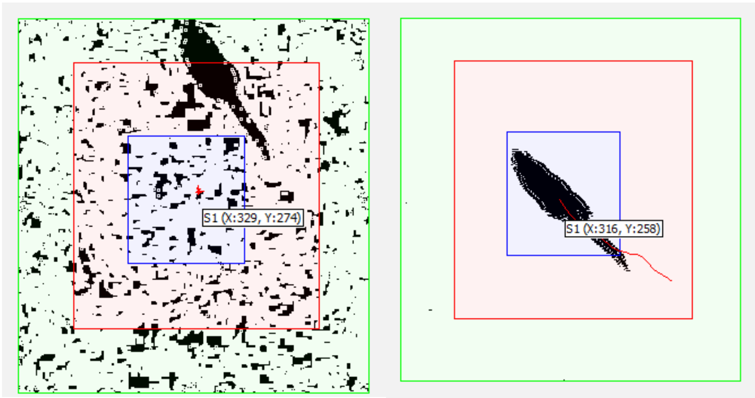
   In order to differentiate changes in the image due to real movements from those produced by reflections, shadows or small bits of not-under-study objects, a tolerance **Threshold** is defined. On the other hand, the boundary outline of the shape is likely to produce artifacts, but it may be disregarded with this **Erosion** control.

   We first recommend the user to set the Threshold and Erosion to the zero value. A lot of background noise is detected during the test.



- **Adjust the Threshold**

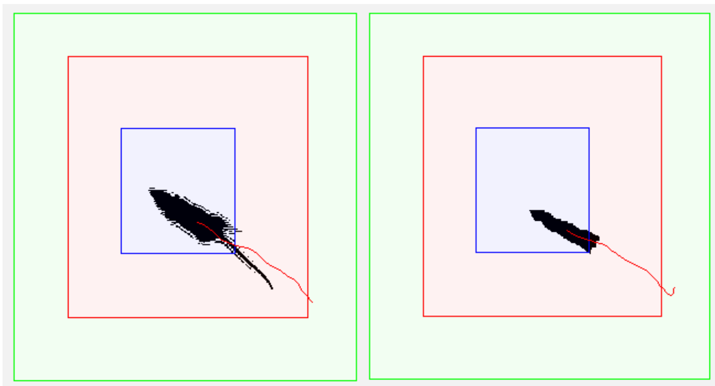
  Increasing the Threshold value removes progressively the background noise (reflection, shadow, small displacement of the camera or the scenery) until only the animal is detected.



- **Adjust the Erosion**

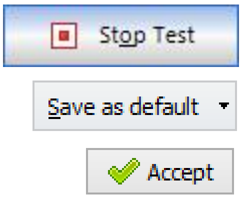
  At all times, SMART calculates the tracking points of the subjects (assuming a homogenous surface weight distribution). Concentric zones are defined from the center of mass out to the exterior perimeter. The external zone (outermost rings) would be likely to produce artifacts, as this is where shadows and reflections are most difficult to discriminate.

  To avoid this problem, the **Erosion** control enables these external rings to be eliminated. To find the optimum setting, start with a value of 1 and gradually increase until the image displayed shows only the shape of the subject. The Erosion is also used to eliminate the animal tail detection.



It is strongly recommended to ensure that a stable volume of pixels of the animal is detected in all the sectors of the experimental area.

If the detection is still difficult to obtain, change the image brightness and contrast (see chapter 8.1) or optimize the experimental detections (see chapter 3.2)



9. If the tracking path is correctly detected, press the **Stop Test** button.
10. If these adjustments are going to be used for every new experimental file, press the **Save as default** button.
11. Press the **Accept** button to save the new detection settings.

8.2.1.3. Anti-vibration filter

Due to the own nature of the basic video-tracking systems, image noise could produce little variations of the centre of masses that could imply a considerable error in the total distance travelled. To minimize such error, check the box **Use noise filtering** and select a filtering level from the list.

Filtering level depends on the level of noise detected in the image. To determine it, put a static object into the arena and try to track it starting with the filter set to zero. If the distance increases, this means that the noise level is high introducing a vibration of the tracking point. Increase the filter value until distance in only increased when the animal moves.

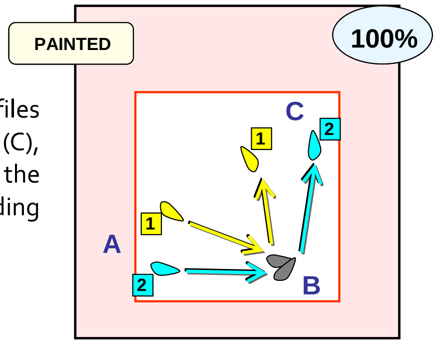
Please note that setting the noise filter too high can cause the system to ignore a real movement of the subject between frames, resulting in speed values that are not accurate.

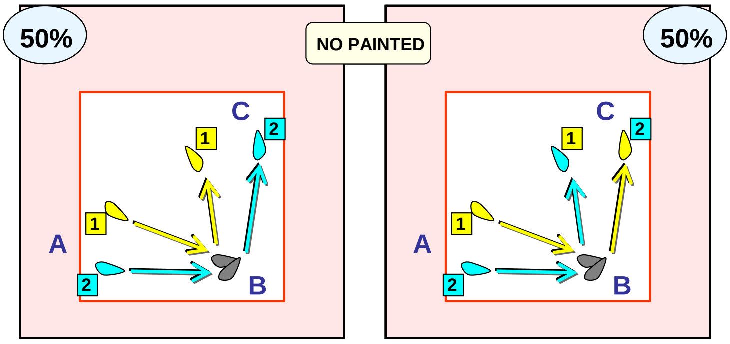
The selection of an optimal anti-vibration filter is not critical during the acquisition of the data, this filter can be changed again during the analysis process for getting a new set of data.

8.2.1.4. Specific considerations for Multiple subject detection (SMART-SI)

The use of SMART using the Center of mass tracking mode will only allow the studying of **global** social interaction behaviors of a group of animals (total number of contact, total distance travelled…). Even if the system will register a track for any of the subjects detected in the experimental area; this mode does not ensure an individual recognition of each subject.

Indeed, before any contact (A), the system is intrinsically able to differentiate the subjects between them. At the moment of the contact (B), the profiles of the subjects overlap. After separation (C), the system will not be able to restore the "correct" initial identity to the corresponding subject.





This means that SMART cannot ensure that the track registered and assigned from each animal is the representation of the displacement of this animal (it can be a mix between the tracks of several subjects).

The animal identification can be improved in 3 ways:

- **Using animals with different sizes**. If the size of the animals is enough different, SMART will not do any mistake in the animal identification.
- **Using SMART with the 3-points tracking detection** (needs the SMART-TW extension), but even in that case, the reliability is low.
- **Using SMART with the color detection** (needs the SMART-TW extension). Indeed, an optimal animal identification in a social interaction test can be ensured using color detection in marked (painted) animals (see Color Detection mode chapter 8.2.4).

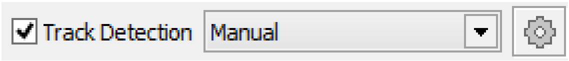
8.2.2. Manual tracking mode

In the manual tracking mode, the position of the subject is not detected automatically and has to be indicated by the user using the mouse-cursor over the image shown in the player.

It is a useful tool for experiments in difficult conditions where automatic track detection is not possible or not reliable. The manual tracking mode works in the same way as the center of mass tracking detection mode, with the difference that the position of the subject is not detected automatically but indicated by the user. All other functionalities remain the same as in the center of mass tracking detection mode with some limitations described further ahead in this chapter.

8.2.2.1. Detection mode selection

Select the **Track Detection - Manual** option in the Detection mode section of the Detection Settings panel.



8.2.2.2. Detection test

As the position of the subject is not detected automatically in the manual tracking mode, no detection test is necessary.

8.2.2.3. Anti-vibration filter

Please refer to chapter 8.2.1.3.

8.2.2.4. Limitations of the manual tracking mode

As there is only one cursor available to indicate the position of only one subject at a time, the following restrictions apply when using manual tracking mode:

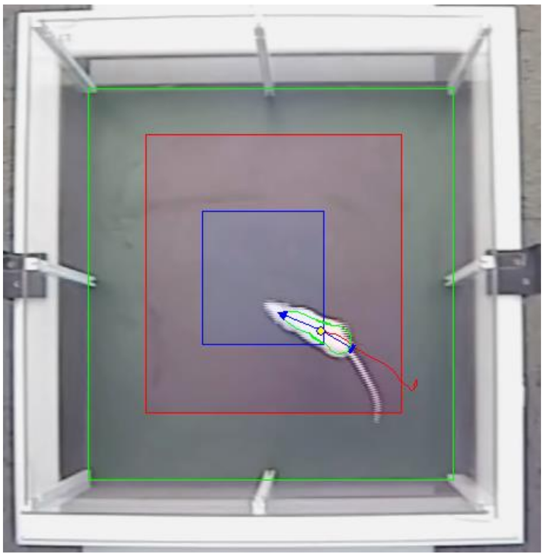
- When using the manual tracking mode, it is not possible to record more than one track in one trial. Each trial to be acquired can contain only one subject. Social interaction specific data cannot be obtained using this mode.
- Although multiple arenas may be defined, when using the manual tracking mode only the data acquisition of one arena can be executed at a time. It is not possible to acquire data of multiple arenas simultaneously using this method.

As the automatic detection of global activity is independent to the automatic detection of the subject's position, SMART is able to acquire simultaneously global activity data when using the manual tracking mode.

8.2.3. 3-points tracking (TriWise) mode

Standard video-tracking systems use the detection of the center of mass for studying the behavior of experimental subjects in a wide variety of different tests. Nevertheless, this measuring method may be considered as insufficient in some applications with very specific needs.

The TriWise technology is an innovation of the Panlab Harvard Apparatus Research and Development team enabling the SMART video-tracking system to extract an advanced model of the animal motion based not only on its center of mass but also on its head and tail position.

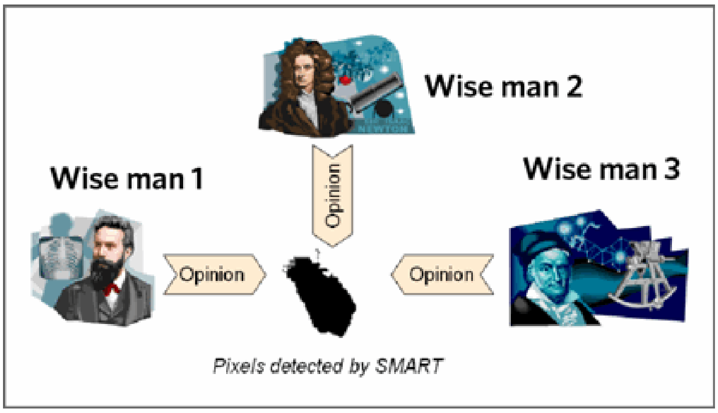


The TriWise technology is based on artificial intelligence techniques applied to obtain always the most natural, realistic and reliable solution.

A range of different criteria are considered in order to determine the position of the head and tail-base from the video sequence. Each criterion is evaluated independently by a specialized "wise man" who gives his opinion about the current and past data. This answer is always accompanied by a reliability level. All the opinions and reliability levels are considered and weighted to obtain the final decision.

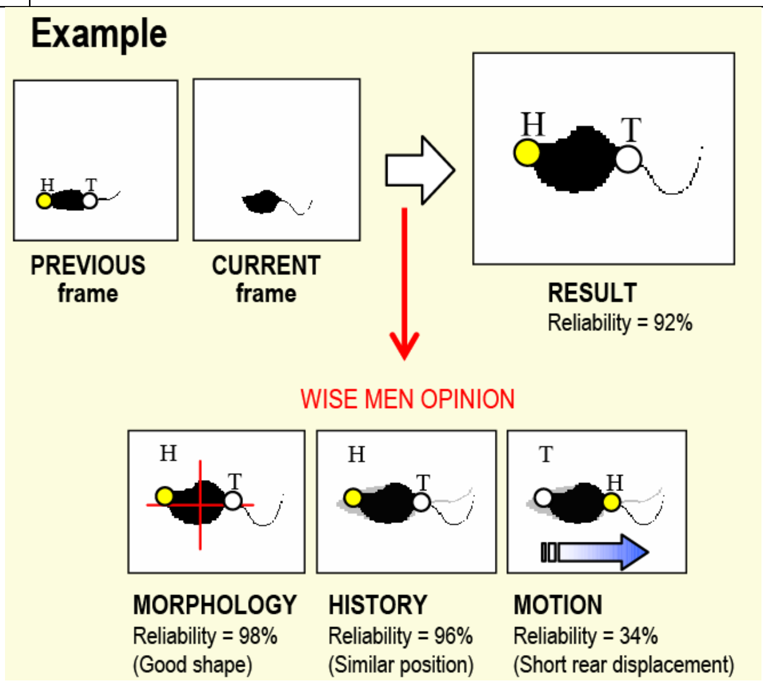
This technology enables SMART to automatically identify and register complex animal behaviors like exploration, rotations, rearing, head-head contacts between identified animals using only the image coming from the camera or digital video file without requiring additional external electronic devices or animal painting.

Furthermore, zone entries criteria become more realistic as more morphological information is considered during the evaluation of the zone transitions.



To determine the position of the center, the head and the tail base of the animal, the following criteria are evaluated:

	**Morphology**: studies the animal's shape and mass distribution.
	**History**: keeps record of the past head and tail base positions.
	**Motion**: its answer is based on the animal displacement direction.



TriWise uses these three criteria to determine the position of the head, center and tail. The weight of each criterion represents its importance. If, for example, the weight of movement is higher than the other, TriWise will consider the movement more important than morphology and the historic stability and will determine the position of the three points based mainly on the movement of the subject.

Applications of the TriWise tracking:

- Knowing the position of one special part of the body of the animal such as the head, center and/or base-tail-plus (object recognition test, social interaction, etc.…)
- Defining its own criteria for considering an entry into a zone (elevated-plus maze, etc.…)
- Registering complex behaviors such as rearing and rotations (open-field test, exploration tests, apomorphine test in unilateral lesions, etc.…)

Using this technology not only avoids having to mark the animal but also allows a more detailed evaluation of some specific behavioral items such as animal exploration (hole-board test, object recognition test, novel object test), location choice (elevated-plus maze, T/Y maze, open-field), rearing (open-field, exploration studies) and rotations (studies using unilateral lesion of dopaminergic systems, cycling behavior).

8.2.3.1. Experimental conditions considerations

The following pints are useful recommendations for setting the experimental conditions for an optimal subject detection when TriWise detection mode is enabled:

- Maximize the image contrast

With all video-tracking systems, the better the image quality and contrast, the better the performance obtained. This point is critical when using the TriWise technology.

Optimum reliability is obtained with black subjects on a white background or white subjects on a black background. <u>High reliability cannot be ensured in low contrast conditions.</u>

Adjusting the camera lens and using the SMART lighting configuration will help produce the sharpest and most contrasted image possible. Always avoid the undesirable artefacts (shadows, reflections, etc.).

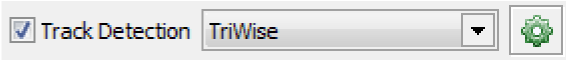
Always use indirect lighting for homogeneous lighting distribution in the experimental area!

- Avoid "obstacles" in the experimental area

We recommend working in experimental conditions in which the shape (or a part of the body) of the animal will not be hidden by "obstacle" placed in the experimental area or related to the structure of the maze used.

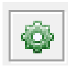
8.2.3.2. Detection mode selection

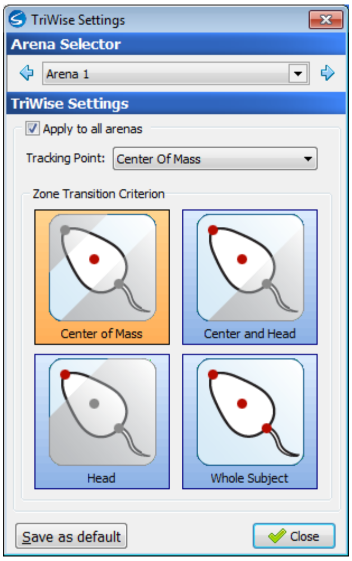
Select the **Track Detection - TriWise** option in the Detection mode section of the Detection Settings panel.



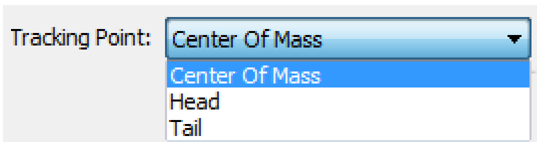
8.2.3.3. TriWise settings

SMART-TW users are provided with an additional **TriWise Settings** panel to configure the capabilities of the extension.

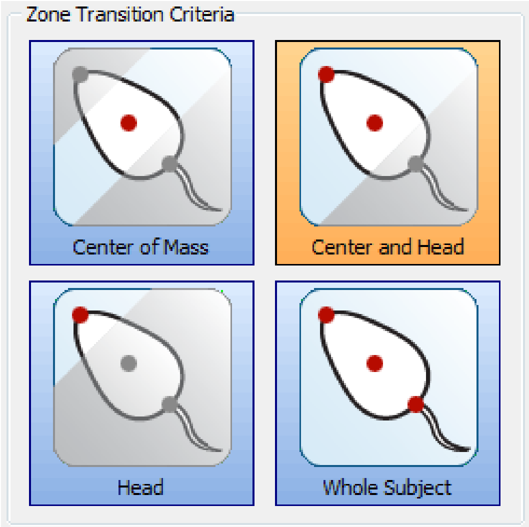
If the **Track Detection – TriWise** mode is selected, the  button located at the right side of the **Track Detection** option is enabled. If the button is pressed, a **TriWise Settings** panel is shown to adjust the TriWise tracking detection parameters.

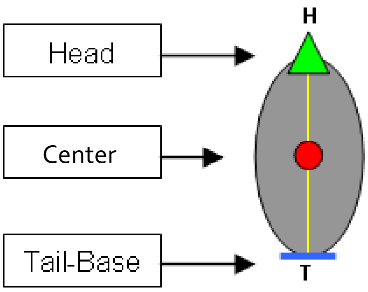


- **Tracking Point**: enables you to choose the tracking point (head, center or tail), and therefore which point SMART will use to calculate parameters such as distance covered and speed during the acquisition process. The coordinates of the 3 points will be registered internally, so the Tracking point can be changed afterward during the Analysis process for generating a new set of data.



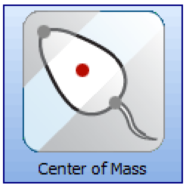
- **Zone transition criterion**: knowing the position of the head, center and tail of the animal, it is possible to define advanced zone transitions criteria.



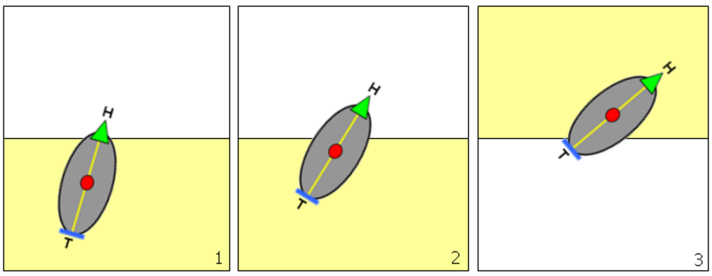


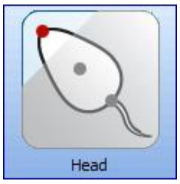
This configuration will be used during the acquisition process for determining when a zone transition occurs. This configuration can be changed afterward during the Analysis process for generating a new set of data.

TriWise provides the following options to decide when the subject moves from one zone into another.

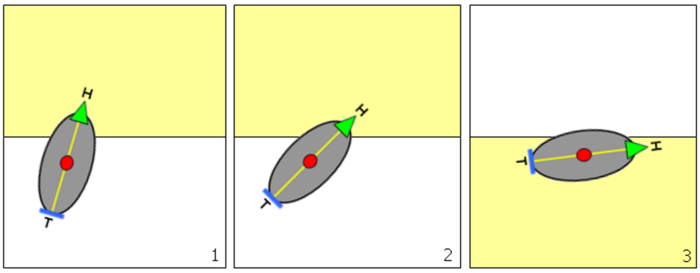


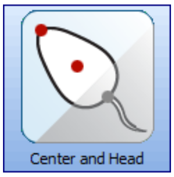
- **Center of Mass**: The animal is considered in the zone when the center point is detected within that zone. For this determination, only the center point is used in the evaluation.





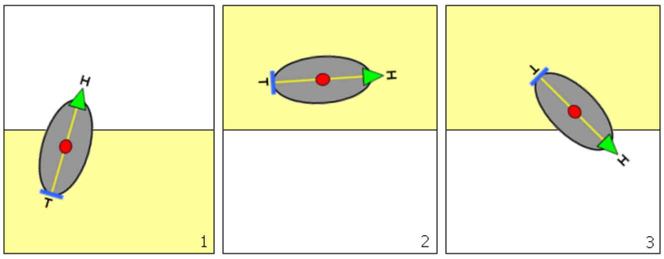
- **Head**: The animal is considered in the zone when the head point is detected within that zone. For this determination, only the head point is used in the evaluation.

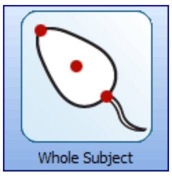




- **Center and Head**: The animal is considered in the zone when the center AND head points are detected within that zone. For this determination, only the center and head point are used in the evaluation.

  If the center and the head are in different zones, no transition is considered to occur. In the first sample acquired, if center and head are in different zones, it is considered that the subject is in the zone where the center point is.

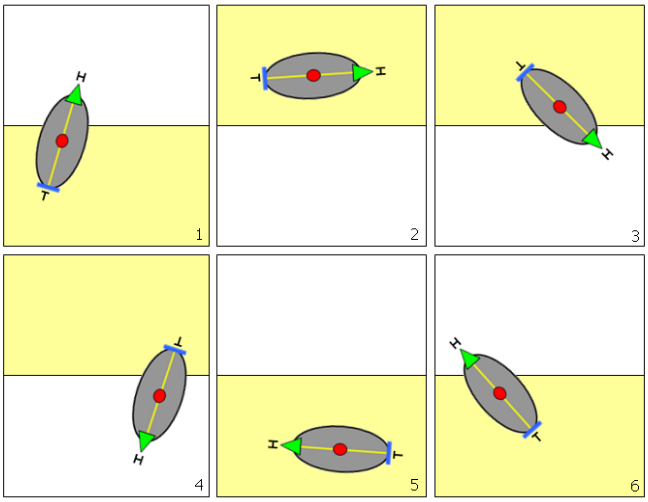




- **Whole Subject**: The animal is considered in the zone when all three points are detected within that zone. For this determination, all three points are used in the evaluation.

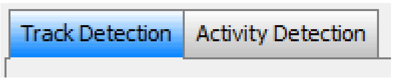
  If the center, head and tail-base are in different zones, no transition is considered to have occurred.

  If the points are in different zones, SMART will consider the subject to be in the zone where the center point is observed.

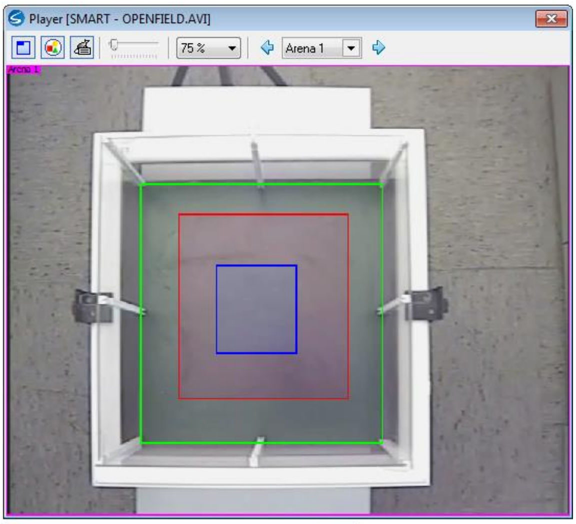


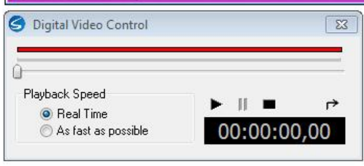
8.2.3.4. Detection test

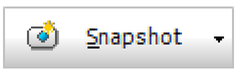
To check the detection, the next steps have to be followed:



1. Select the **Track Detection** mode and the corresponding tab in the **Detection Settings** section.
2. Remove any subject from the experimental area for taking the snapshot that will be used as image of reference. The only difference between the experiment image (with animal) and the reference image (without animal), is the presence or absence of the experimental subject (the lighting and background conditions should be the same). If a video digital file is used, move the cursor of the Digital Video Control panel until a frame without animal.



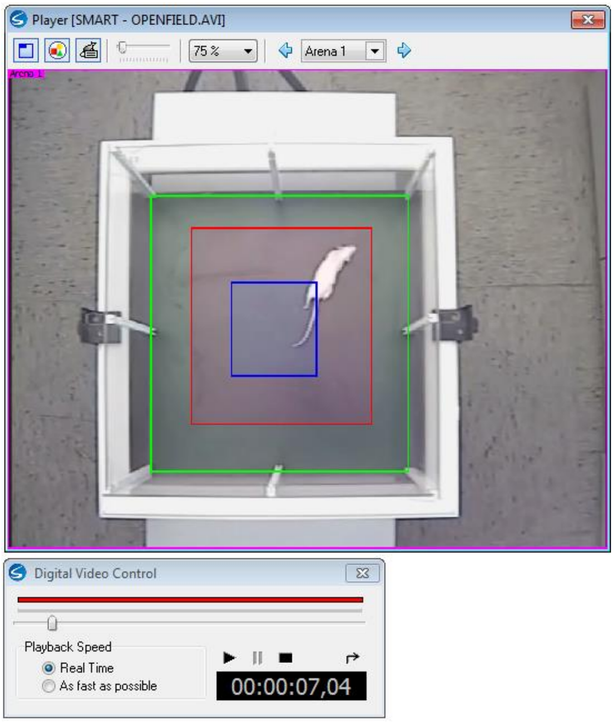




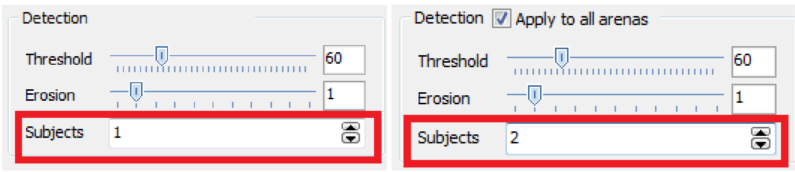
3. Press the **Snapshot** button to record the current image (frame) as the image of reference (snapshot). If the video does not contain any image of reference

without animal, please refer to chapter 8.2.6 for more details on how to edit a snapshot.

4. Put a pilot subject (o object with similar color) into each arena to test the detection process. If your image source is a digital video file, use the **Digital Video Control** panel again to set a new starting point for the tracking detection test.



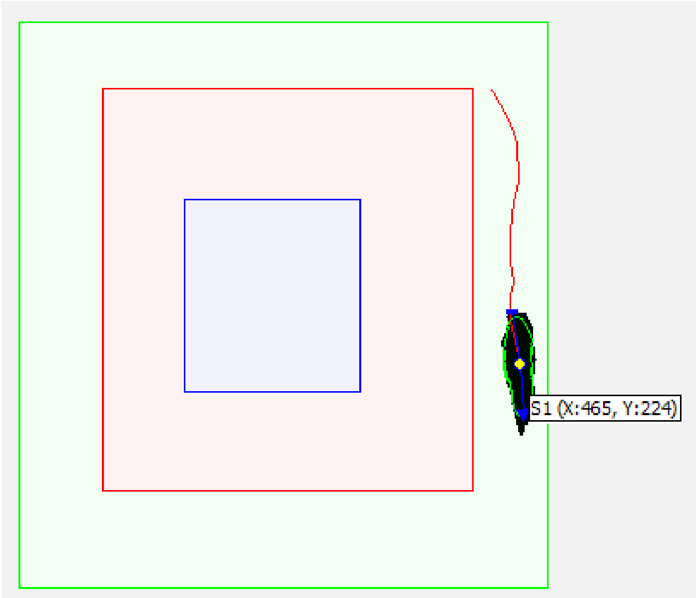
12. Set the number of Subject to be detected. Selecting more than 1 Subject is only allowed when working with the **SMART- SI** module.



The Subjets selector is the Test panel is only used during the detection testing process. This number has no effect on data acquisition. In data acquisition, the only configuration that will fix the number of subjects that will used for each trial is the number of subject that will be assigned to the trial in the Scheduler (see Chapter 11.2 for more details about the Scheduler configuration for more than 1 subject).

5. Press the **Start Test** button to verify if the detection process can identify the subject correctly. The Calibration process (see chapter 6) has to be done before starting the Test. The difference between the current image and the image of reference is converted in pixel (black dots). Detection is considered as optimal when the only black dot shown in the player is the animal. In that case, the red tracking line should closely follow all the animal displacements, a white label with the animal number and coordinates is shown and a blue

arrow showing animal head (triangular extremity), center (central circle) and base-tail (short line extremity) placements.

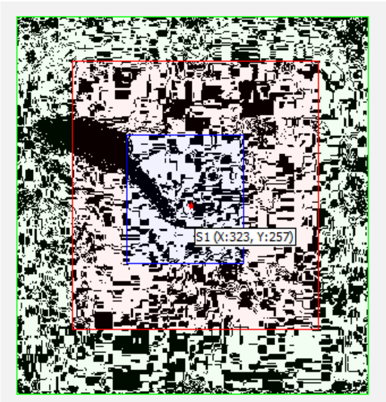


If such detection is not obtained, adjust the Threshold and Erosion parameter for optimizing the detection process.

6. Adjust **Threshold** and **Erosion** parameters to get a sharper and noise-free test image.

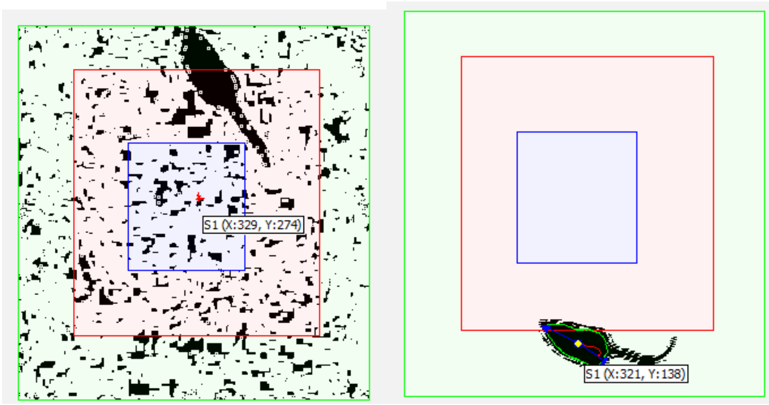
   In order to differentiate changes in the image due to real movements from those produced by reflections, shadows or small bits of not-under-study objects, a tolerance **Threshold** is defined. On the other hand, the boundary outline of the shape is likely to produce artifacts, but it may be disregarded with this **Erosion** control.

   We first recommend the user to set the Threshold and Erosion to the zero value. A lot of background noise is detected during the test.

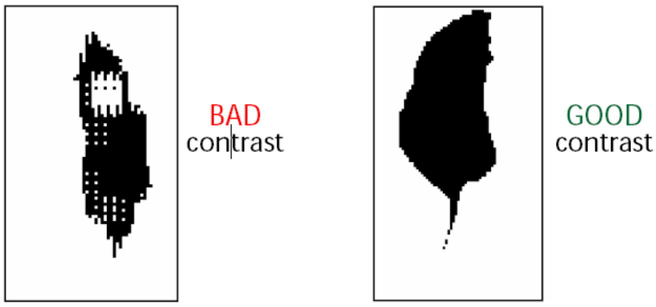


- **Adjust the Threshold**

Increasing the Threshold value removes progressively the background noise (reflection, shadow, small displacement of the camera or the scenery) until only the animal is detected.



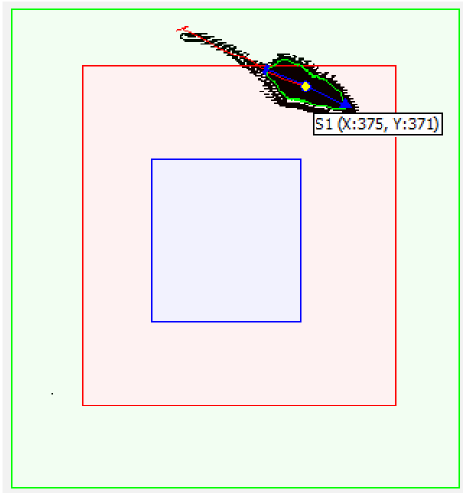
Although they are great tools to optimize the tracking process, both tend to distort the animal shape that makes the automatic visual recognition difficult. Try to keep the animal shape as natural as possible, avoiding blurred edges. The shape of the animal has to be as sharp as possible.



- **Adjust the Erosion**

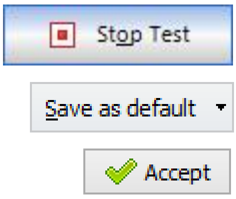
At all times, SMART calculates the tracking points of the subjects (assuming a homogenous surface weight distribution). Concentric zones are defined from the center of mass out to the exterior perimeter. The external zone (outermost rings) would be likely to produce artifacts, as this is where shadows and reflections are most difficult to discriminate.

To avoid this problem, the **Erosion** control enables these external rings to be eliminated. To find the optimum setting, start with a value of 1 and gradually increase until the image displayed shows only the shape of the subject.



An erosion value set to zero (or very close to zero) is highly recommended. If some small pixel dots can be observed in the Test player when the Erosion is set to the minimum value, it is suggested to use the additional internal filter included in the TriWise option to ignoring them.

If the detection is still difficult to obtain, change the image brightness and contrast (see chapter 8.1) or optimize the experimental detections (see chapter 3.2)



7. If the tracking path is correctly detected, press the **Stop Test** button.
8. If these adjustments are going to be used for every new experimental file, press the **Save as default** button.
9. Press the **Accept** button to save the new detection settings.

8.2.3.5. Anti-vibration filter

Please refer to chapter 8.2.1.3

8.2.3.6. Specific considerations for Multiple subject detection (SMART-SI)

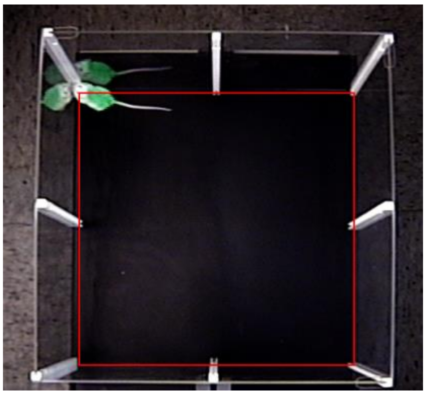
The use of SMART using the 3-points TriWise tracking mode will only allow the studying of **global** social interaction behaviors of a group of animals (total number of contact between user-selected points: head-head, Head tail, Head center, center-center..., total distance travelled...). Even if the system will register a track for any of the subjects detected in the experimental area; this mode does not ensure a 100% reliable individual recognition of the subjects assigned to the same trial.

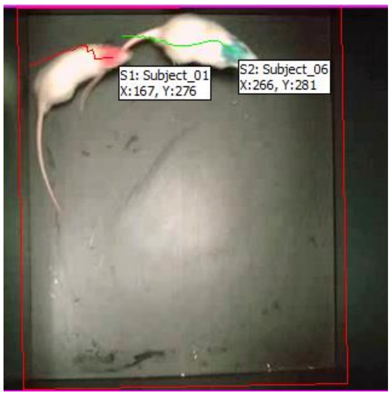
The animal identification can be improved in 3 ways:

- **Using animals with different sizes**. If the size of the animals is enough different, SMART will not do any mistake in the animal identification.
- **Using SMART with the color detection** instead of 3-points detection (needs the SMART-TW extension). Indeed, an optimal animal identification in a social interaction test can be ensured using color detection in marked (painted) animals (see Color Detection mode chapter 8.2.4).

8.2.4. Color tracking mode

The SMARTTW module provides an additional advanced detection mode for color tracking that can be use for single-subject tracking or multiple subject tracking. In this mode, any color can be considered as a mark that can be tracked by SMART (black, grey scale and white colors included).

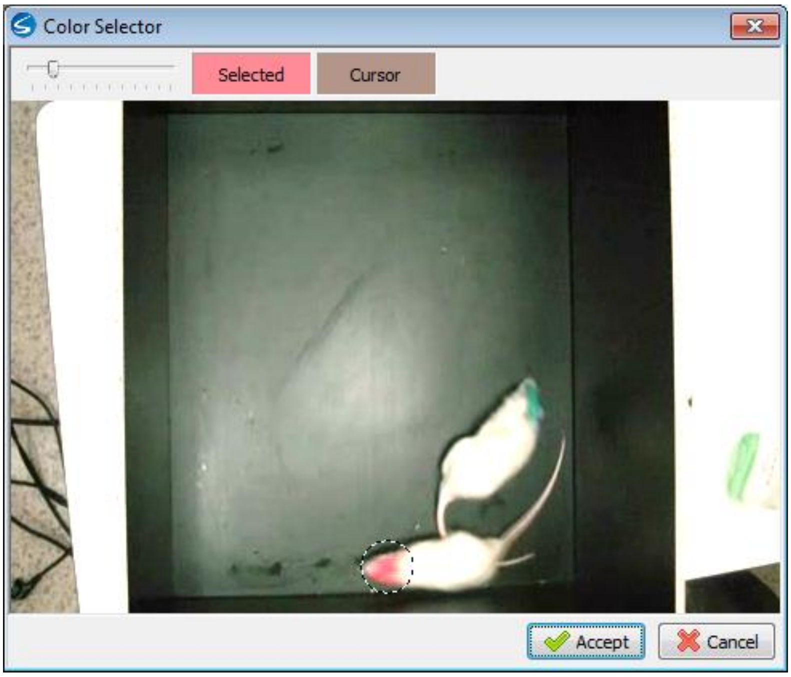




In this mode, there are no comparisons of the image of the experiment with a previous image of reference.

The technique consists in indicating to the system which color has to be tracked using the color-selector tools provided by SMART. SMART will register a color pattern of all the color of the pixels contained in the area selected by the user.

During the tracking process, the dots of pixels showing the selected color pattern will be recognized by the system. The position of the detected color dot is then calculated for each image as the mean of all the pixels detected by the system. The track is formed by consecutive detection of the color dot position along the time.



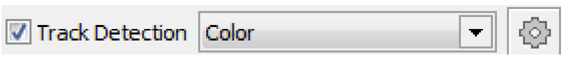
Applications of the color tracking:

- Knowing the position of a specific part of the body of the animal such as the head, center and/or base-tail-plus (object recognition test, social interaction, etc.…)

- Registering complex behaviors in a social interaction tests (when combined with the SMART-SI module) such as contacts taking into consideration the variation of distance between a specific part of the animal body of the subject (head for instance) instead of the center of mass.

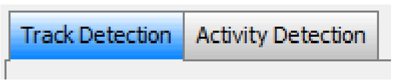
8.2.4.1. Detection mode selection

Select the **Track Detection - Color** option in the Detection mode section of the Detection Settings panel.



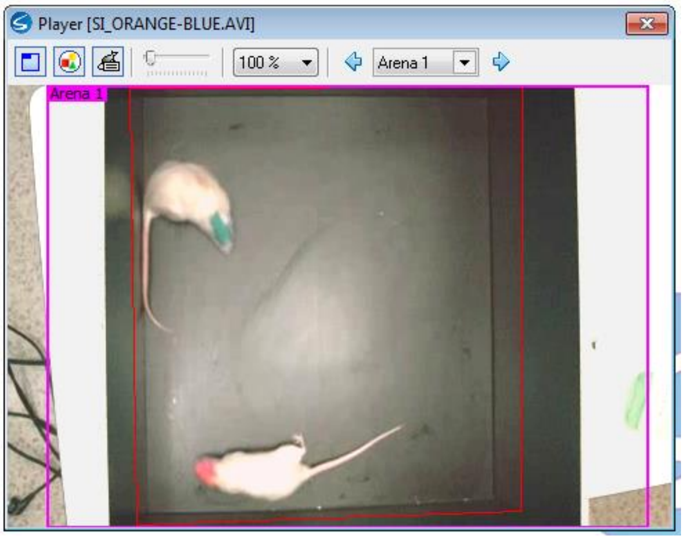
8.2.4.2. Detection test

To check the detection, the next steps have to be followed:

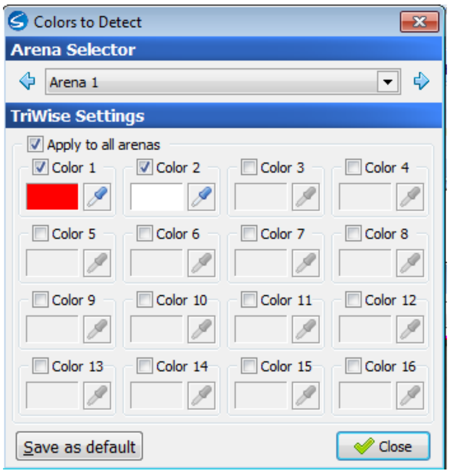


13. Select the **Track Detection** mode and the corresponding tab in the **Detection Settings** section.
14. Put one pilot subject marked with one color (o an object with similar color) into the arena. If your image source is a digital video file, use the **Digital Video Control** panel to set a new starting point for the tracking detection test in which the animal is seen. If using several animals (SMART-SI module), mark the animals in a different color and put them in the arena (when using video

digital file, set the **Digital Video Control** setting point to a frame in which all the animal and their mark can be seen.



15. Press the **Colors to Detect** button to access to the **Colors to Detect** tool.

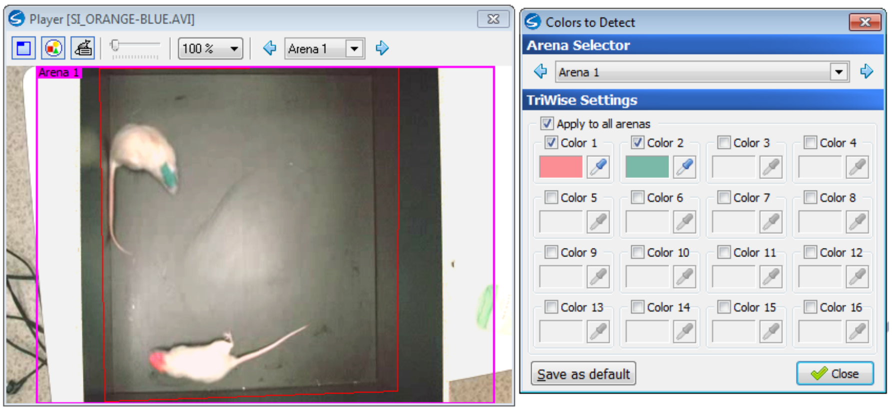


16. Set the color to detect of the first animal by pressing the **Select a color from player...** button for the **Color 1** marked section.

17. Select the color to detect by targeting the cursor on the animal mark. The color detected by the cursor is the average color of all the pixels included in the surface of the cursor and is shown in the Cursor button Cursor . Use the (or scroll the roll of the mouse) tool for reducing the surface of the cursor until the Cursor button shows the color to detect.

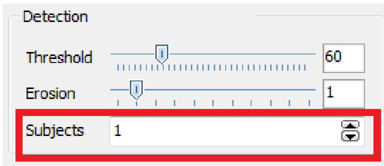
18. Click on the cursor mouse to accept the selection. The selected color will be then shown in the Selected button Selected.

19. Repeat the same process for a second (and others) subject if needed:

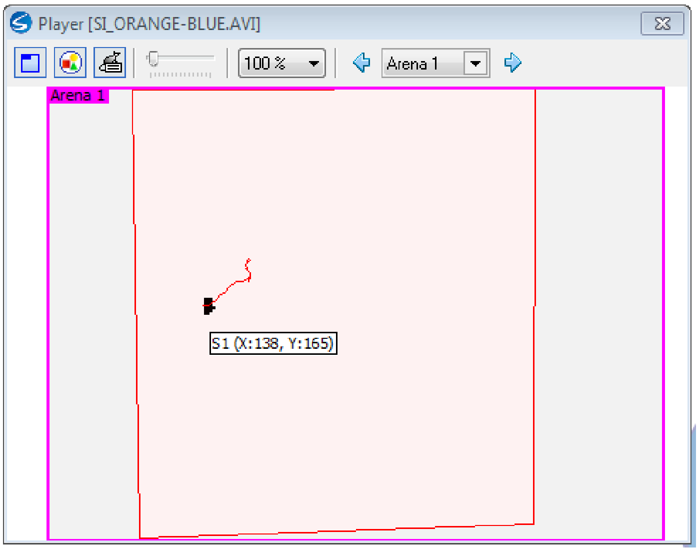


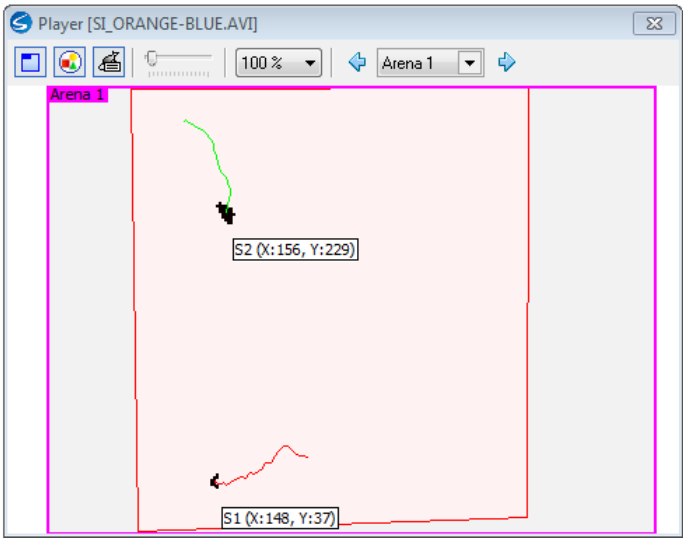
20. Press the Close button when the color selection is finished.

21. Subject selector. When working with the **SMART- SI** module, a subject selector is available in the detection Threshold section. The selection of this configuration has no effect on the detection settings process. The selection of this configuration has also no effect on data acquisition process. This parameter is only used for testing detection using the center of mass tracking detection and TriWise tracking detection modes.



22. Press the **Start Test** button to check whether the color detection process can identify the subject or the subjects correctly. The Calibration process (see chapter 6) has to be done before starting the Test. The dot(s) of the detected color(s) is converted in pixel (black dots). Detection is considered as optimal when the only black dot shown in the player is the targeted dot of color (see example bellow of optimal detections achieved with 1 subject and with 2 subjects. In that case, the red tracking line should closely follow all the color dots displacements and a white label with the animal number and coordinates is shown.



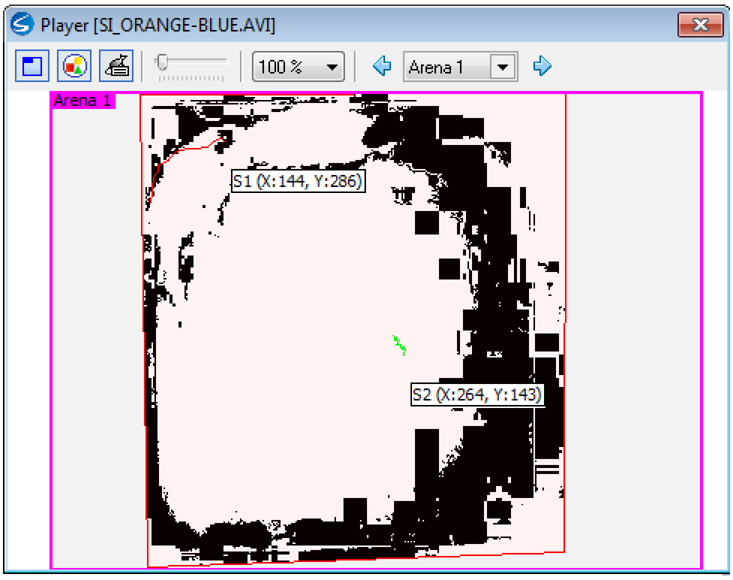


If such detection is not obtained, adjust the Threshold and Erosion parameter for optimizing the detection process.

23. Adjust **Threshold** and **Erosion** parameters for optimal detection.

    In order to minimize artifacts produced by reflections, shadows or small bits of not-under-study objects, a tolerance **Threshold** is defined. On the other hand, the boundary outline of the shape is likely to produce artifacts, but it may be disregarded with this **Erosion** control.

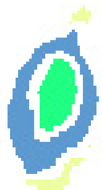
We first recommend the user to set the Erosion to the zero value. Depending of the Threshold value set a lot of background noise is detected...or nothing is detected!



- **Adjust the Threshold**

  In the color detection mode, the threshold is an automatically calculated index mixing Color Hue and Saturation parameters.

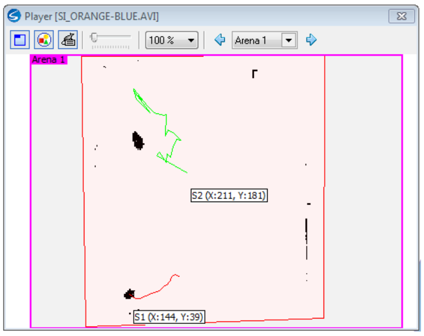
  The **Hue** is an angle dimensioned parameter (between 0 and 360º) related to tonality. The entered value is an interval of tolerance for color distinction. Normally, it ranges from 10 to 20º. A very narrow tolerance would make the system consider as different colors two points of the same colored surface, while a very wide one would cause two different but similar colors to be regarded as a single one.

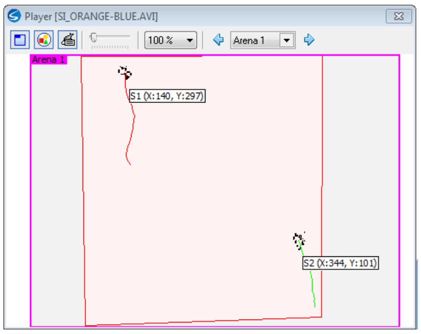


  The figure on the left shows an example of what could happen when the Hue Threshold value is higher than it should be: SMART mixes the colors of the subjects, and so the positions of the subjects are incorrectly calculated. On the contrary, the figure on the right is an example that shows the result of a correct configuration of the Hue Threshold control (note that the shape of the pixels detected is clearly painted with a single color).

  The **Saturation** is the saturation tolerance range for a subject color (it works the same as explained for hue). It is a color/brightness ratio, in percentage (0% = black; 100% = pure color) A tolerance interval is given here to exclude wrongly detected changes due to glints User should be advised that, internally, Smart® rejects all those pixels which have a saturation lower than 25% (they can be considered grey tonalities and not color tonalities).

Moves the **Threshold** value to the right or to the left until the subject is (or the subjects are) clearly identified.

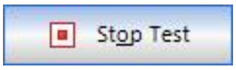




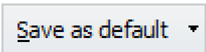
- **Erosion**

  When using color detection, the Erosion parameter is commonly set to the zero value because the SMART will focus the detection to the targeted colors and ignore any of the other colors displayed in the experimental area.

If the detection is still difficult to obtain, ensure that the targeted colors are only existing on the animals, and not in any other area of the experimental area. Additionally, change the image brightness and contrast (see chapter 8.1) or optimize the experimental detections (see chapter 3.2).



24. If the tracking path is correctly detected, press the **Stop Test** button.



25. If these adjustments are going to be used for every new experimental file, press the **Save as default** button.

26. Press the **Accept** button to save the new detection settings.

8.2.5. Global activity mode

Activity measurement is the task of detecting animal movements even without animal's displacement. The activity is evaluated by counting the pixel change rate between two consecutive images. Unlike the tracking mode, all the pixels detected are taken into account allowing a fine evaluation in the change of the animal shape.

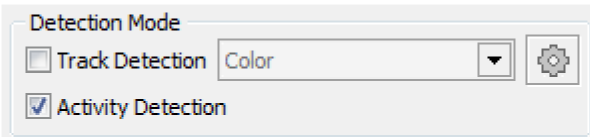
Applications of global activity mode:

Particularly recommended for the analysis of animal movements (with or without any displacement) allowing the calculation of a wide variety of related parameters (amount of activity, resting/slow/fast movements, immobility episodes).

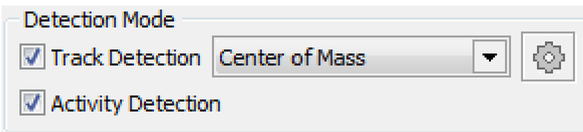
Some standard applications are animal(s) global activity, forced swimming, fear conditioning (freezing) and tail-suspension, activity of a group of animals in a social interaction study.

8.2.5.1. Detection mode selection

Select the **Activity Detection** option in the Detection mode section of the Detection Settings panel.



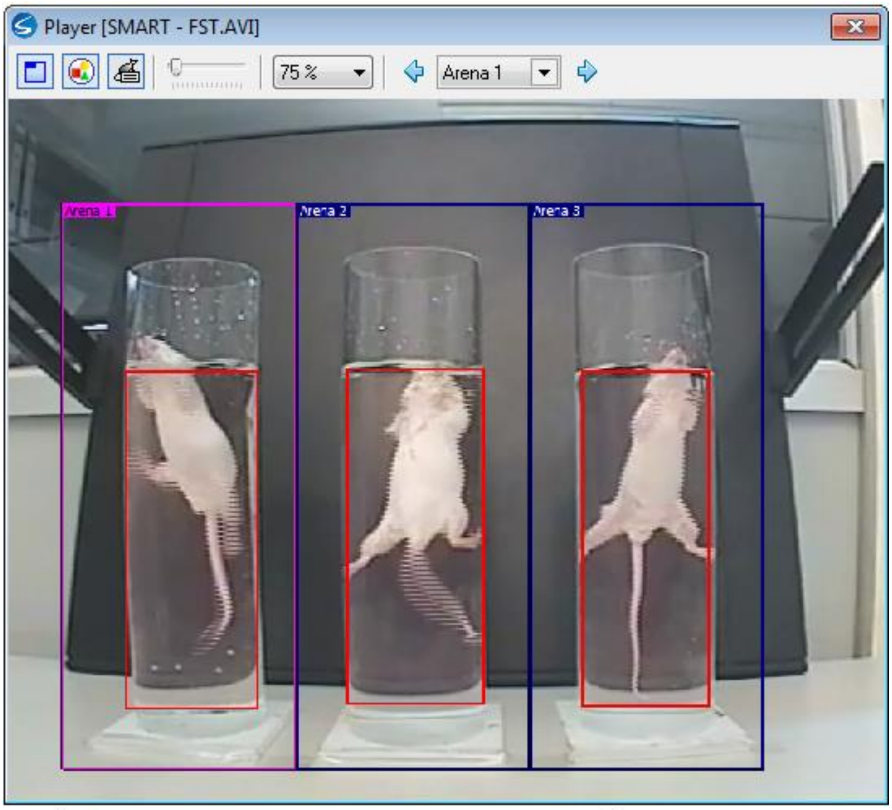
The Activity Detection can be carried out simultaneously with any of the other Tracking detection modes.

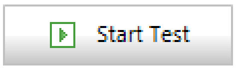


8.2.5.2. Detection test

To check the detection, the next steps have to be followed:

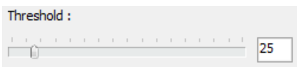
1. Put a pilot subject into each arena to test the detection process. No snapshot has to be taken to detect activity. If your image source is a digital video file, use the Digital Video Control panel to set a starting point for the video.





2. Press the **Start Test** button to check whether the detection process can identify the subject correctly. The Calibration process (see chapter 6) has to be done before starting the Test. The image will turn to test mode, allowing real-time visualization of adjustment effects.

3. The difference between the experiment image and the reference image (that is, what is being detected and processed by SMART), will be numerically materialized in pixel format (black dots), the rest, (that is, that which is identical to the reference image), will be displayed as white.



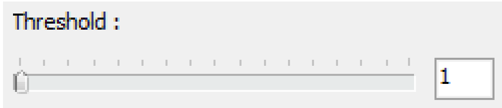
4. Adjust the **Activity Threshold**

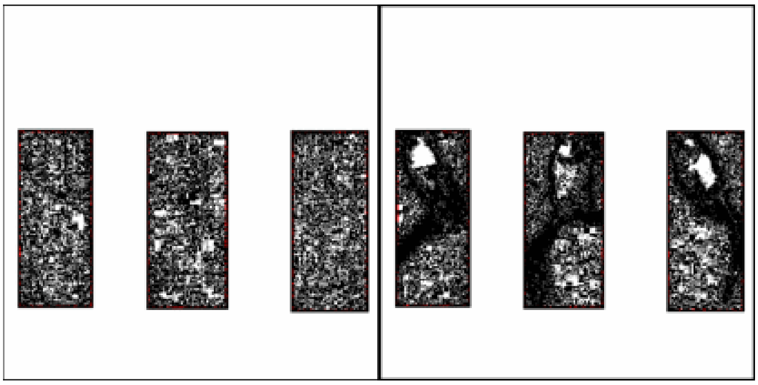
   For calculation purposes, activity is measured as surface change rate. SMART evaluates pixel changes rate and converts it to a surface change rate using the calibration values. Since a perfectly static image is not possible (interferences always cause a few pixels to change) a threshold must be defined. See the Activity Threshold box at the bottom of the screen. A threshold equal to zero will make the system take into account all changes in the image, while higher values would only consider significant changes.

The difference between two subsequent images (that is, what is being detected and processed by SMART), will be numerically materialized in pixel format. The identical areas between the two images, will be displayed as white.

The optimal threshold setting makes the test image white; illustrating no displacement is produced and black spotted at the slightest movement. Here is an example for setting threshold for a forced-swimming test.

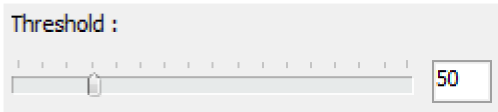
- Threshold too low

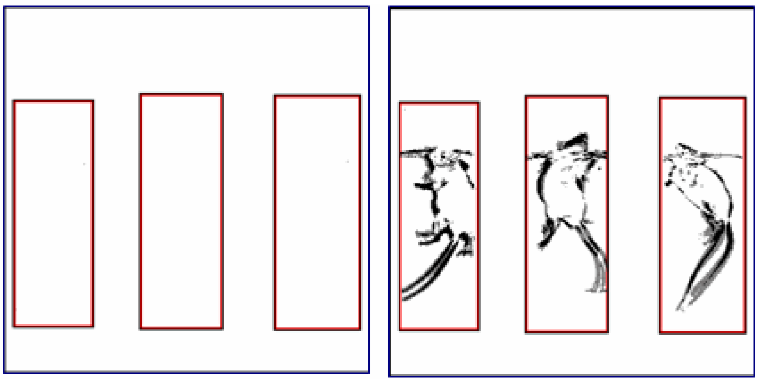


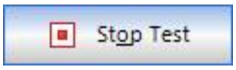


In these images with and without subjects, the activity threshold has to be increased since SMART detects too much background noise.

- Optimal threshold







5. Once the activity parameters have been set, return to the normal camera image by pressing the **Stop Test** button.
6. If these adjustments are going to be used for every new experimental file, press the **Save as default** button.
7. Press the **Accept** button to save the new detection settings.

8.2.6. Snapshot Editor

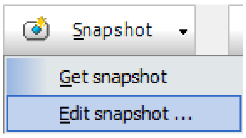
This tool is only available for the Tracking detection modes (Center of mass, 3-points TriWise, color detection).

When a digital video source is used to acquire data, it is a strongly recommended to have at least 1 second of the video without the animal inside the box so that a snapshot of the clean box could be taken.

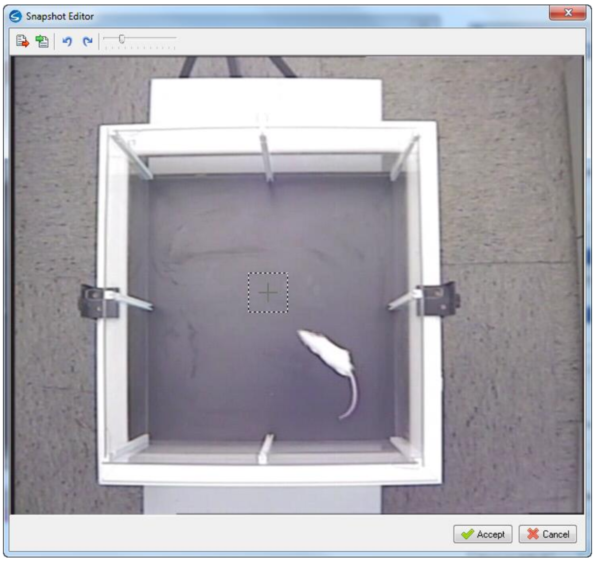
Whether this was not possible or whether the video was accidentally recorded without that issue in mind, SMART provides a **Snapshot Editor** tool to (1) remove the animal and other artifacts in the snapshot image or (2) to import a snapshot without animal from another video registered in the same experimental conditions. This tool is only available when a digital video file is used (not when a live image source is selected).

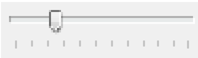
To do that:

1. Use the **Digital Video Control** panel to seek to a position in which the biggest area of the arena's floor is visible (that is, the animal occupies the smallest area in the arena). Avoid positions in which the animal is reflected in the arena's walls as reflections are more difficult to remove.

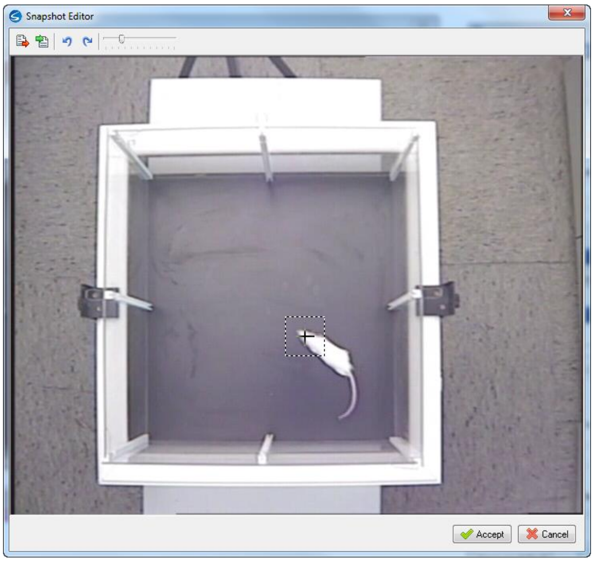


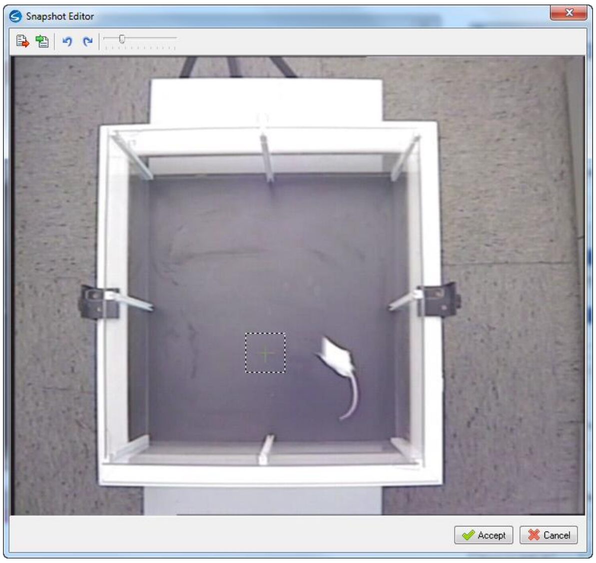
2. Press the **Snapshot** button to capture the current snapshot.
3. Press the arrow button located at the right side of the **Snapshot** button and select the **Edit snapshot...** menu option.



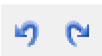


4. Adjust the size of the cleaning brush through the toolbar or by moving up or down the wheel in the mouse. A larger brush size facilitates the task of cleaning the animal but provides worst results.
5. Click an area of the image occupied by the animal and, with the left button of the mouse still pressed, move to a clean space of the arena close to the current one.





6. Release the left button of the mouse when a homogeneous surface is obtained.



7. Use the **Undo**/**Redo** buttons in the toolbar if the final result is not suitable.
8. Repeat the steps 4 to 7 until the animal is completely removed and the resulting snapshot is clean from imperfections.

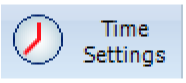
9. Export the resulting snapshot if you plan to import it later in the same experiment or in a different one.

Only the exported snapshots with exactly the same image size than the current digital video file can be imported.

10. Accept the **Snapshot Editor** tool to make use of the new snapshot for testing the detection.

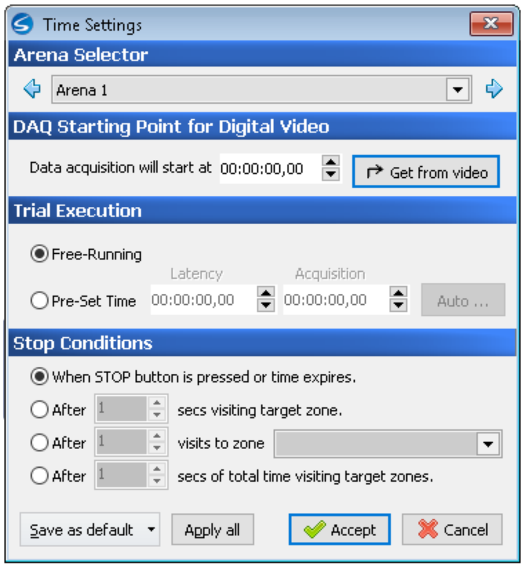
11. Start a detection test (as explained before in the previous chapters) and adjust the thresholds to get an optimal detection with the new snapshot.

Snapshots edited manually are stored and retrieved from the experimental file so that it is not needed to edit the snapshot every time the experiment is opened. If a new snapshot is taken the edited snapshot will be lost.



9. Time settings

The **Time Settings** panel allows the definition of the trial's timing, that is, the temporal conditions that will apply to the following trials.

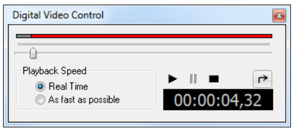


SMART-MA

An "Arena Selector" control is provided for SMART-MA users within the **Time Settings** panel to adjust the timing parameters for each arena independently in case more than one arena is defined.

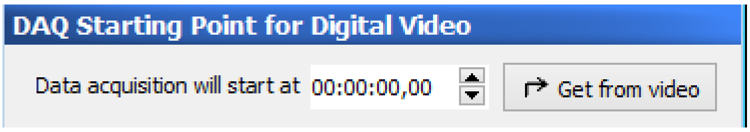
Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

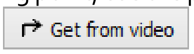
In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

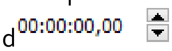


9.1. DAQ Starting Point

In case the currently selected image source is a digital video file, then it is possible to specify the time of the video where data acquisition will start.



This is particularly useful when there are several trials recorded in one video. To establish the starting point, use the player to navigate to the desired starting point and click on the 

button. Alternatively, it is also possible to introduce manually the starting point time into the provided field 

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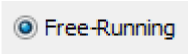
SMART-MA

If more than one arena is defined, then it is possible to specify a different starting point for each arena independently. During data acquisition, if multiple arenas are started simultaneously, then the video will be spooled to the first starting point of all arenas to be started and data acquisition on the rest of the arenas will start when the video reaches the starting point of each arena.

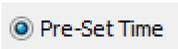
Notice that only the starting points of those arenas which are to be started are considered. The starting points of the arenas that are not to be started are ignored. For example, if during data acquisition only one arena is started, then the video will be spooled to the starting point of this arena, independently if there are other arenas with an earlier starting point defined.

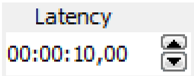
9.2. Free-running



The **Free-Running** option gives the user the possibility to start and stop the tracking process manually by pressing the START and STOP buttons. Thus, duration of the acquisition period will entirely depend upon the user's on-line commands.

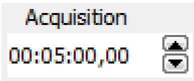
9.3. Pre-set time





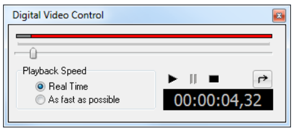
The **Pre-Set Time** option allows fixing a preconfigured **Acquisition period** (experiment duration) and a **Latency period**, which is the time interval before acquisition actually starts. This latency period can be regarded as a "waiting interval", after START button is pressed, which can be used to place an animal in its cage or simply give the subject some time to acclimate to the new environment.

Please notice that the **Latency period** is started after the START button is pressed **and the animal has been detected** in the experimental area.

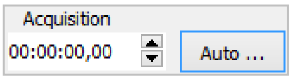


Latency and acquisition periods must be set in hh:mm:ss,cc format so up to 99h 59m 59s, 99c of data acquisition is allowed in this pre-set mode.

No data is registered during the latency period. In all cases, the track will only begin when the animal is detected into the experimental area.

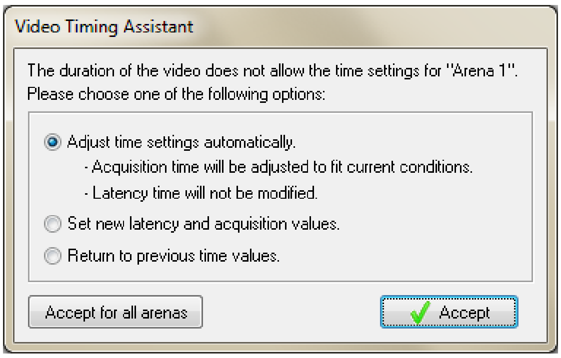


If a digital video file is selected as an image source, the acquisition pre-set time cannot be longer than the total duration of the video.



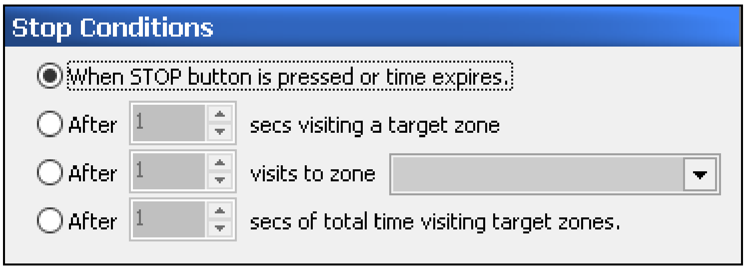
In the Time settings panel, use the **Auto** button to visualize the maximum acquisition time allowed by the current digital video file.

If an inadequate acquisition or latency time is set, SMART will show an assistant that helps in setting the right times. The assistant will be launched automatically after pressing the **Accept** button.



9.4. Stop conditions

Depending on the experimental module used within your experimental file, different stop conditions can be chosen for interrupting the data acquisition process.



SMART-CS

SMART-CS module enables you to freely set the stop conditions for your trials, independently on the experimental modules licensed.

- When STOP button is pressed or time expires

  The acquisition process stops automatically when the time set in the **Trial Execution** section is elapsed or when the STOP button is pressed manually.

- After <x> secs visiting a target zone

  The tracking process stops automatically when the subject has spent a user-defined consecutive time (*x* secs) in a zone defined as Target. This option is commonly used in water maze experiments in which the tracking process can be stopped when the subject has spent at least 15 secs (this value can be different depending on the user) in the platform zone.

  Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

- After <x> visits to zone <z>

  The tracking process stops automatically after a user-defined number of visits (*x*) into a user-selected zone (z).

  Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

- After <x> secs of total time visiting target zones

  The tracking process stops automatically when the subject has spent a user-defined total time (*x* secs) in zones defined as Target.

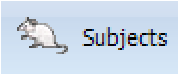
Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

It is always possible to interrupt the data acquisition by pressing the STOP button at any moment during the tracking process.

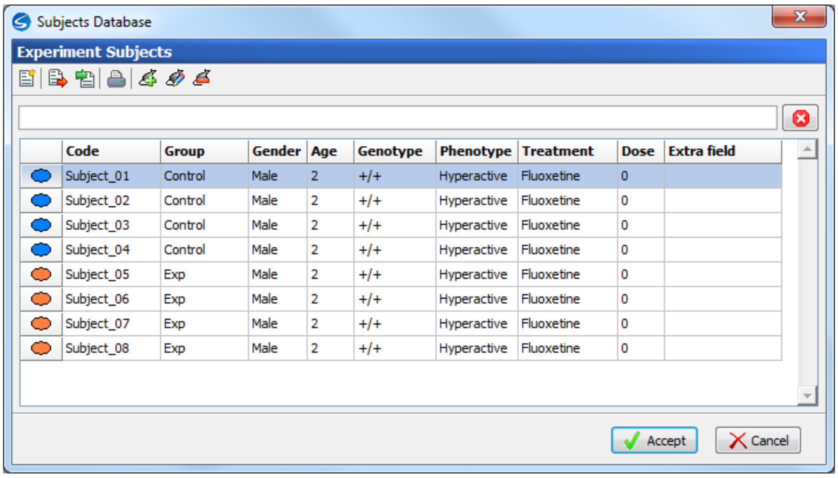
If these time settings are going to be used for every new experimental file, press the **Save as default** button.

10. Subjects database

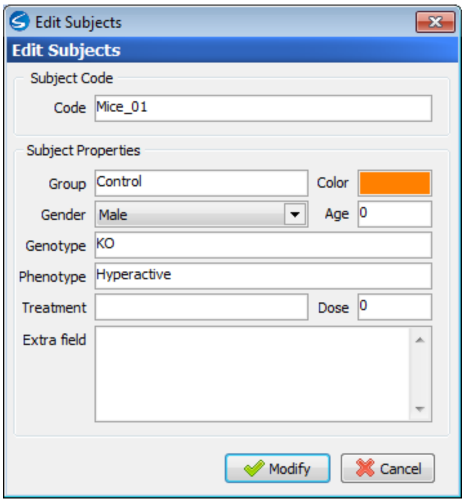
Any experiment is carried on over a set of experimental subjects. These subjects must be registered into the experimental file before starting trials (data acquisition).



To create a database of experimental subjects, enter the **Subjects Database** manager by pressing the **Subjects** button in the **Experimentation Assistant** bar.



10.1. subjects data



The following fields are provided for user edition:

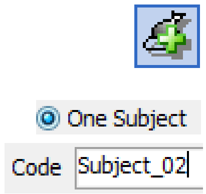
- **Subject code**: name of the subject
- **Subject Group**: experimental group related to the subject.
- **Color**: the Color field does not mean representing the color of the physical color of the subject, This property is commonly used for two common proposals: (1) a better visualization of the different groups in the list, (2) the selected color for each animal will be used in data acquisition for the visual

representation of the arrow used for the automated detection of the subject 3-points (head, center and base-tail) by the TriWise tracking detection mode (see example bellow when the TriWise detection is used combined with the SMART-SI module).

- **Gender**: gender of the subject. Can be Male or Female.
- **Age**: age of the subject (the unit is not précised, can be days, months or years)
- **Genotype**: Genotype of the subject (genetic characteristics of the subject), can be wild-type, knock-out for some specific genes, transgenic...
- Phenotype: Phenotype of the subject (physical o physiological characteristics of the subject), can be hyperactive, blind, brown fur color, etc....
- **Treatment**: treatment used, if any...
- **Dose**: dose of the treatment used, if any.
- **Extra field**: free edition text available for adding any other characteristics the user would like to export in the report for analysis.

10.2. Adding new subjects

10.2.1. Adding one new subject



1. Press the **+** button to add new subjects to the database.

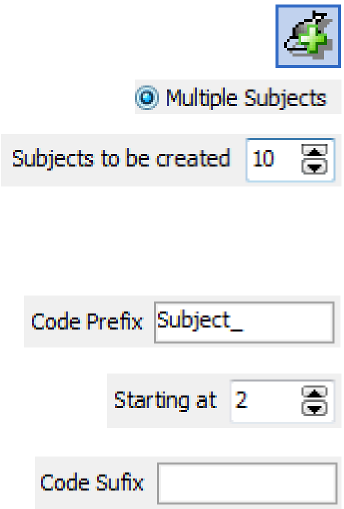
2. With the **One subject** option already selected, enter the subject's code.

3. Fill the rest of the subject's information in the **Subject Properties** section.

4. Press the **Create** button to add the new subject.

The new subject to be created cannot have the same code of another subject already belonging to the same group. If that happened, change the code or the group and try again.

10.2.2. Adding a batch of multiple subjects



1. Press the **+** button to add new subjects to the database.

2. Select the **Multiple subjects** option.

3. Enter the number of subjects to be created between 2 and 999.

4. Every new subject created will have a code composed by three parts combined in sequence:

   a. A code prefix.

   b. A code number: which starts at the number specified in the field **Starting at**.

   c. A code suffix.

5. Fill the rest of the subject's information in the **Subject Properties** section. Every subject will have the same properties.

6. Press the **Create** button to add the new subject.

New subjects cannot have the same code of another subjects already belonging to the same group. If that happens, SMART automatically adds a suffix "(n)" to the subject's code, being n an incremental number used to differentiate them (e.g. "Subject_10" is renamed by "Subject_10 (2)").

10.3. Editing the properties of the subjects

10.3.1. Editing the properties of one subject

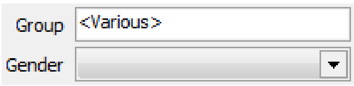
1. Make double click over the subject or select it and press the **Modify selected subjects** button.
2. Edit the subject's code or any of the rest of the properties.

3. Press the **Modify** button.

10.3.2. Editing the properties of multiples subjects

1. Select the subjects to be edited. The combination of the [SHIFT] and [CTRL] keys and the left button of the mouse allow you to select a variety of ranges very easily.

2. Press the **Modify selected subjects** button.
3. The **Edit Subjects** panel shows the properties of all the selected subjects. The value of the common properties is shown directly but heterogeneous properties are shown as "<Various>" or as an empty field.



4. Edit the subject's properties. Enter the values to apply to all the selected subjects at the same time. Let the rest of the properties unchanged.

5. Press the **Modify** button.

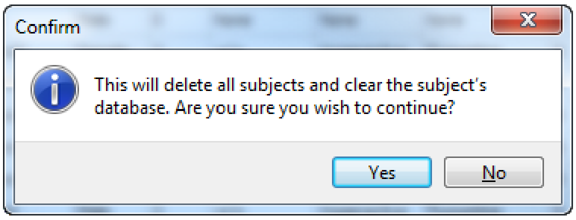
10.4. Deleting subjects

1. Select the subjects to be deleted. The combination of the [SHIFT] and [CTRL] keys and the left button of the mouse allow you to select a variety of ranges very easily.

2. Press the **Delete selected subjects** button.

3. If multiple subjects are to be deleted, then a confirmation message is shown. Accept the message to definitely delete the subjects.

Press the **Clear Subjects** button and accept the confirmation message for deleting all the subjects at once from the database.



As other changes within the subject's database, deleted subjects can be recovered only if the **Subjects Database** panel is closed by means of the **Cancel** button. If the panel is accepted, changes done in the subject's database cannot be undone.

10.5. Saving the subjects database

To save the changes done within the subject's database, press **Accept** button of the **Subjects Database** panel.

If the changes done should not be saved, press the **Cancel** button.

All the changes done within the subject's database can be recovered only if the **Subjects Database** panel is closed by means of the **Cancel** button. If the panel is accepted, changes done in the subject's database cannot be undone.

10.6. Other tools regarding subjects management

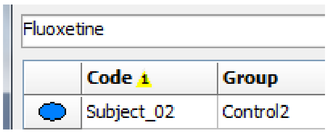
10.6.1. Sorting the subjects database

Left click column headers for main sort index. Click again on the header to change the sorting direction. Add secondary sort indexes with [SHIFT] + left click.

Code 2	Group 1	Gender
Subject_03	Control	Male
Subject_04	Control	Male

Place the cursor on a column-separator line in order to change the width of the columns.

10.6.2. Searching for subjects in the database



The subject's database includes a useful tool to facilitate searching for subjects with properties matching a specific text.

1. Enter the text to search for in the filter box located just under the subject's table.

   As keys are being pressed, the subject's table is automatically filtered to show only those subjects with the text inside any of their properties.

2. Press the **Clear search** button located at the right side of the filter box to cancel the filter.

10.6.3. Exporting and importing the subjects

The complete subjects' database can be exported to a Microsoft Excel® file.

1. Press the **Export subject list** button.

2. Select the destination folder and file name and press the **Save** button.

This file can be edited manually and then imported in a different experimental file.

A2 | f_x Subject_01

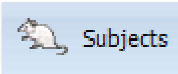
	A	B	C	D	E	F	G	H	I	J
1	**Code**	**Color**	**Group**	**Sex**	**Age**	**Genotype**	**Phenotyp**	**Treatment**	**Dose**	**ExtraField**
2	Subject_01	16744448	Control	Male	2	+/+	Hyperactiv	Fluoxetine	0	
3	Subject_02	16744448	Control	Male	2	+/+	Hyperactiv	Fluoxetine	0	
4	Subject_03	16744448	Control	Male	2	+/+	Hyperactiv	Fluoxetine	0	
5	Subject_04	16744448	Control	Male	2	+/+	Hyperactiv	Fluoxetine	0	
6	Subject_05	4227327	Exp	Male	0	+/+	Hyperactiv	Fluoxetine	0	
7	Subject_06	4227327	Exp	Male	0	+/+	Hyperactiv	Fluoxetine	0	
8	Subject_07	4227327	Exp	Male	0	+/+	Hyperactiv	Fluoxetine	0	
9	Subject_08	4227327	Exp	Male	0	+/+	Hyperactiv	Fluoxetine	0	

Some versions of Microsoft Excel® may warn you that the Excel file generated by the exportation of a subject list has a different format than the specified by its extension. In that case, accept the warning message to open the file normally.

Although manual manipulation can be done in the exported file, please keep in mind that the new information must fulfil the rules of a coherent subject database (e.g. two or more subjects belonging the same group cannot have the same code, color numbers must match the Windows® color palette, gender must be "Male" or "Female" only, and fields age and dose must be a number equal or greater than zero, although age does not admit decimals).

In order to import a previously exported subject list:

1. Open the experimental file in which the subject list is to be imported.



2. Access the **Subjects Database** manager.

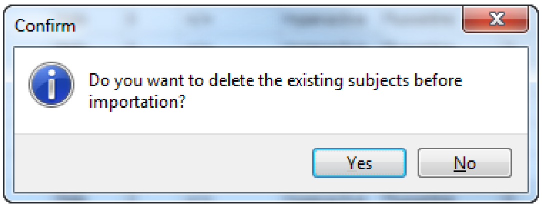
3. Press the **Import subject list** button.

4. Locate the folder and file in which the subject list is stored. Then press the **Open** button.

   The subjects within the file are automatically inserted in the subjects' database of the experimental file.

5. Accept the **Subjects Database** tool.

If the current subjects' database already contains subjects, a warning message is shown before importing the new list:

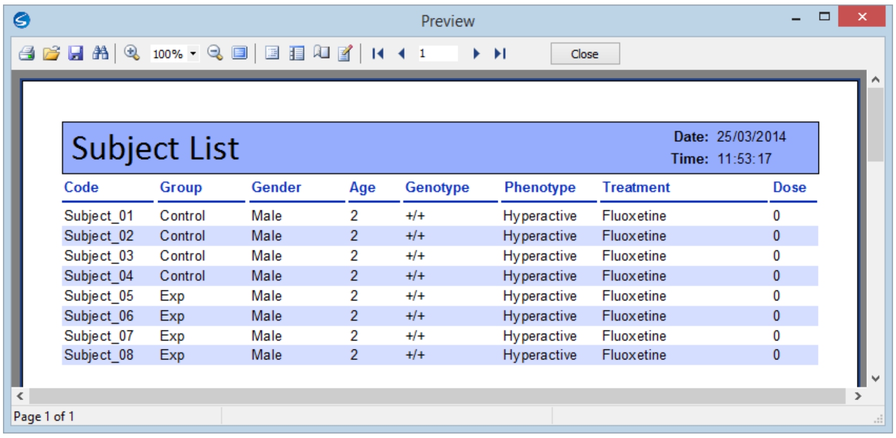


If the subjects' database must be cleared before importing the new list, accept the message. If the subject database is not cleared before importing the new list, the subject's code of the imported subjects will be automatically renamed to avoid a duplication of codes in the same group.

10.6.4. Printing the subjects database

1. Press the **Print subject list** button.

2. Navigate through the pages of the report using arrow buttons in the **Report Preview** window.



Subject List

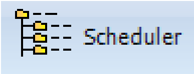
Date: 25/03/2014
Time: 11:53:17

Code	Group	Gender	Age	Genotype	Phenotype	Treatment	Dose
Subject_01	Control	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_02	Control	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_03	Control	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_04	Control	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_05	Exp	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_06	Exp	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_07	Exp	Male	2	+/+	Hyperactive	Fluoxetine	0
Subject_08	Exp	Male	2	+/+	Hyperactive	Fluoxetine	0

3. Prepare your printer for printing the report.

4. Press the **Print** button to print the report.

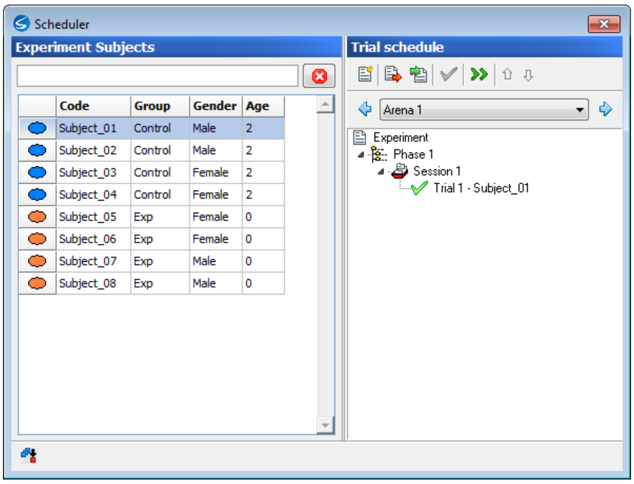
11. Experimental scheduler



SMART provides a **Scheduler** tool to set up the plan for the experiment.

The Scheduler allows the user to define the different phases, sessions, trials and subjects planned to be executed within the experimental project. All these elements are arranged in a tree-view list starting with the "Experiment" node.

Defining an experimental schedule enables:

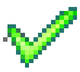


- Automatic transition from one subject to the next during the acquisition of tracks without having to enter the name and characteristics of each animal every time the data acquisition starts or finishes.
- Having a list of all the subjects used in the experiment saved, as well as the order in which they have been used (reminder).
- Reuse of lists established in previous experiments with the subjects in the same or different order.
- Combine analysis results of a group of trials and the evolution of the subjects in each group along the time.

The **Scheduler** panel is split in two sections:

- The experiment subjects list: at the left side of the panel.
- The trial schedule itself: at the right side of the panel.

The trial schedule comes with a predefined plan including a single trial (trial 1) within a session (session 1) and a phase (phase 1). That trial is automatically assigned with the first subject in the database (Subject_01).



The trial is selected automatically as "the next trial" to be executed. This property is shown as a green tick at the left side of the trial name.

A new clean schedule can be started by pressing the  button located the the left side of the **Trial schedule**'s toolbar.

11.1. Compact and extended view

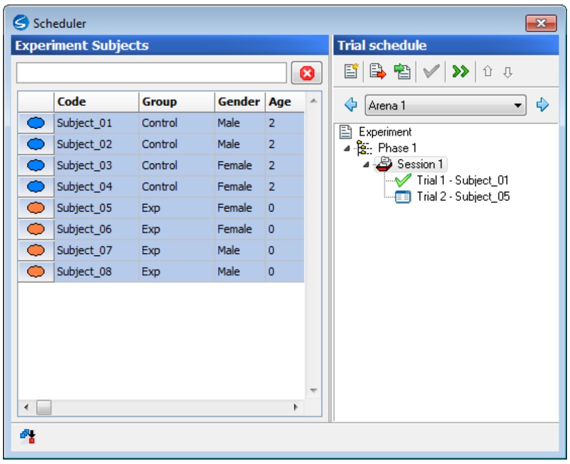
The **Scheduler** panel is provided in form of a *floating window*, that is, the panel can be kept opened while other tasks are running.

This is especially useful during the data acquisition as you can easily identify which subject is the next to participate in a trial and thus prepare it before starting. Moreover, the trial schedule tree also allows you to inspect the final results of a finished trial by clicking its node.

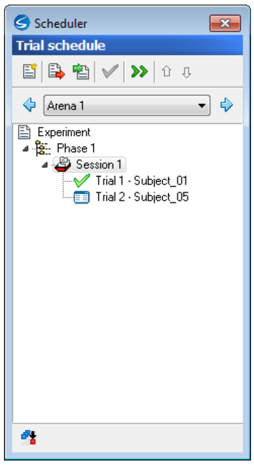
In order to work with the rest of the application while the **Scheduler** panel is shown, compact and expanded views are provided.

Expanded view (default view) is designed to provide all the information regarding the experiment subjects and plan. Compact view is designed to provide only the information regarding the experimental plan (**Trial schedule** section only).

In order to switch from the expanded view (default view) to the compact view, press the **Change view** button located at the left bottom corner of the **Scheduler** panel.



Expanded view



Compact view

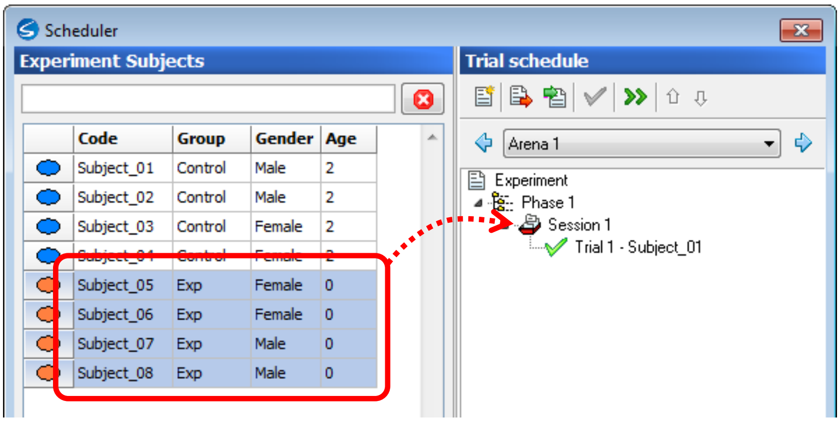
11.2. Managing trials

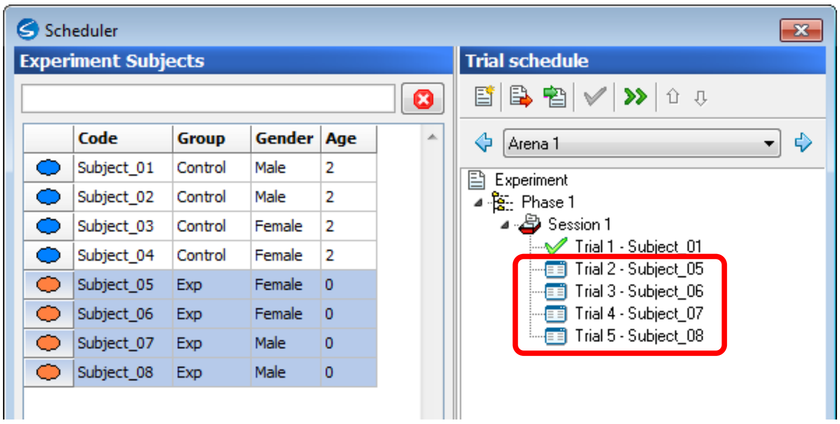
11.2.1. Adding new trials to a session

In order to add a new trial (or a batch of new trials) to a particular session:

1. Select the subjects that will participate in the trials in the **Experiment Subjects** section. Use the left button of the mouse in combination with the [CTRL] and [SHIFT] keys to select a group of subjects.

2. Drag the selected rows in the table and drop them into the session node at the **Trial schedule** section.





Trial numbers always start at 1 and are automatically increased by one every time a new trial is added to the session.

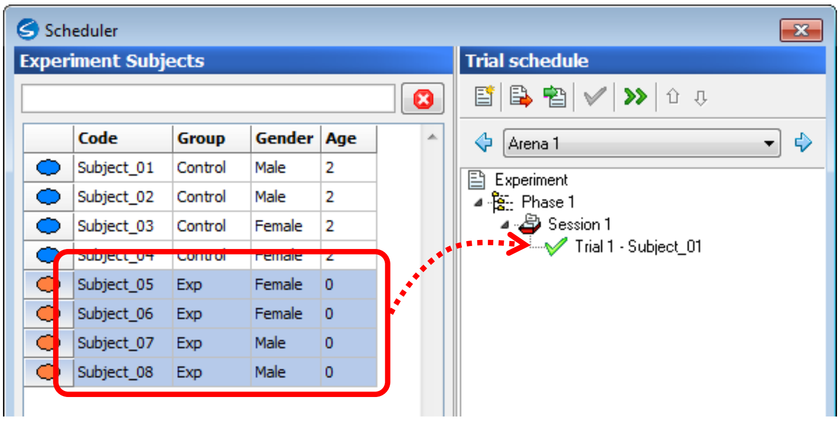
Different icons are shown in the tree view of the schedule to identify the status of the trials :

- The trial has not been executed, contains no data and is not selected for the next execution.

- The trial is the next one to be executed in the plan. Another trial can be selected as next by means of the same button in the toolbar.

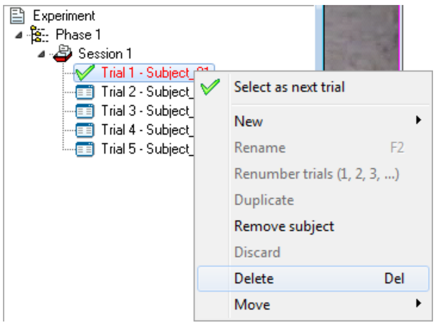
- The trial has been executed and finished. Only these trials can be then analyzed.

When using the **SMART-SI** module for social interactions studies in a group of animals, several subjects can be assigned to the same trial. To do that, select the subjects in the experimental Subjects table and drag them to the **Trial** node.



11.2.2. Deleting a trial

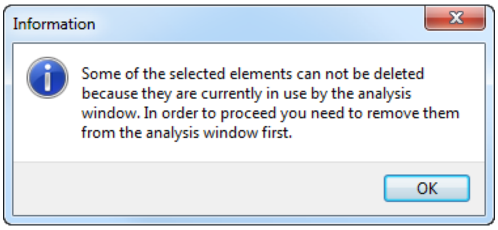
In order to delete a trial already defined, click on the trial's node with the right button of the mouse and select the **Delete** option. Then confirm the deletion message.



Trials can be also deleted quickly by using the [DEL] key.

If a finished trial is deleted, the data acquired will be lost as well. If the experimental file was saved, the information will not be recovered unless a backup file was saved previously. If a trial was unintentionally deleted, DO NOT SAVE the experimental file, close it and reopen it again to recover the information. However, other changes done since the last saving will be lost.

Trials already selected to be analyzed within the **Analysis** module cannot be deleted.

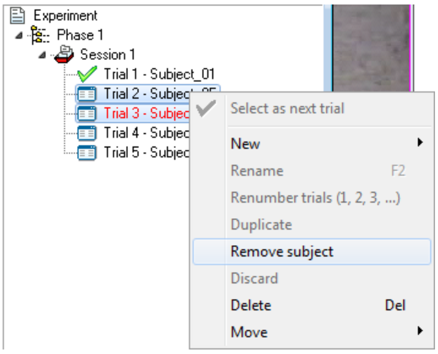


Before deleting the trial, remove it from the analysis list. Please refer to chapter 14.3 for more details on how to remove trials from the analysis list.

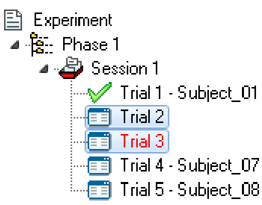
11.2.3. Removing the subject of trials

1. Select the trials from which the subject should be removed. Use the left button of the mouse in combination with the [CTRL] and [SHIFT] keys to select a group of trials in the schedule's tree.

2. Click with the right button of the mouse over any of the selected trials and select the **Remove subject** option. Then confirm the removing.



If the subject is removed from a trial, it is still shown in the schedule's tree but no subject code is shown.



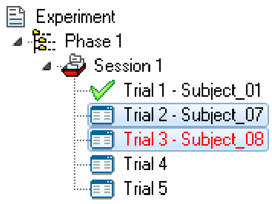
The **Remove subject** option is not available when working with a Trial containing multiple subjects when working with the **SMART-SI** module.

11.2.4. Moving the subjects within a session

1. Select the trial nodes that should be moved within a session. Use the left button of the mouse in combination with the [CTRL] and [SHIFT] keys to select a group of trials in the schedule's tree.

2. Click with the right button of the mouse over any of the selected trials and select the **Move** option. Then select any of the movement options available (Top, Up, Down or Bottom).

The up/down arrow buttons in the **Trial schedule**'s toolbar also facilitates the task of moving the selected trials up and down.



When subjects are moved within the session, the trial numbering is kept - only the subjects are changed from a trial to another.

Please note that trials cannot be moved out of the session to which they belong.

The **Move** subject options are not available when working with a Trial containing multiple subjects when working with the **SMART-SI** module.

11.2.5. Distributing subjects into arenas

SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Trial schedule** section of the **Scheduler** panel to define the trials for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and manage its trials as explained in the chapter 11.1.

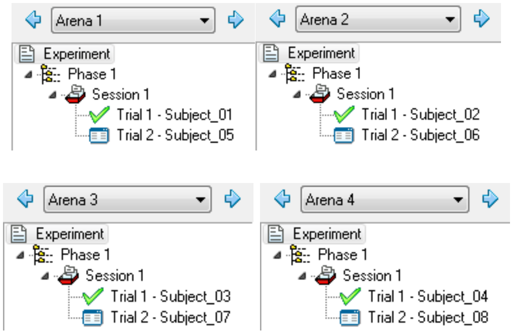
In order to facilitate a quick distribution of subjects to the defined arenas, an efficient tool is provided:

3. Select the subjects in the **Experiment Subjects** table that should be distributed within the existing arenas. Use the left button of the mouse in combination with the [CTRL] and [SHIFT] keys to select a group of subjects.

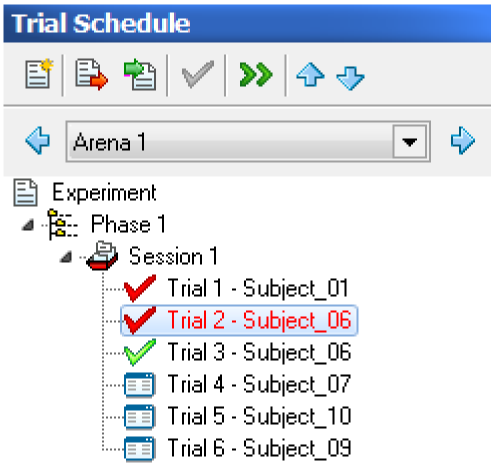
4. Right click over any of the selected trials and select the **Move** option. Then select any of the movement options available (Top, Up, Down or Bottom).

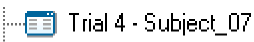
5. Select the session desired and the new trials will be automatically inserted after pressing the **Accept** button.

The selected subjects (in the order shown in the table) will be automatically assigned in sequence to a new trial for each arena defined. For example, if 8 subjects are selected (Subject_01 to Subject_08) and distributed along the Session 1 of 4 arenas, the following trials are created:

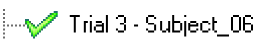


11.2.6. Trial status

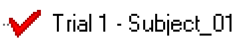




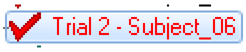
Atrial market with icon is a programmed trial that remains to be done.



A trial marked with the icon is the trial selected for the next data acquisition.



A trial marked with the icon is a trial already used for data acquisition.

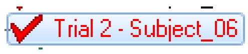


A highlighted trial is a trial selected for the view of the related data in the runtime panel shown in the data acquisition section.

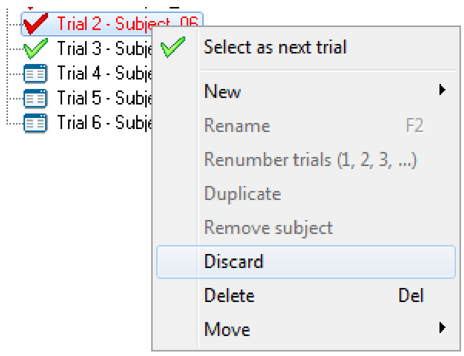
11.2.7. Discarding a trial

The data registered in a trial can be discarded for allowing the selection of the trial for a new data acquisition process. Follow the next steps:

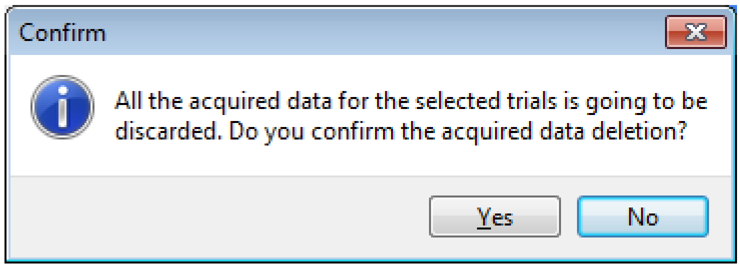
- Select the trial you would like to repeat.



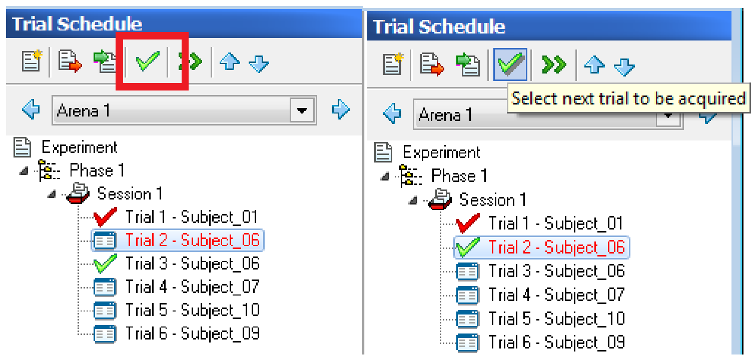
- Right-click in the trial and select the **Discard** option in the menu



- Confirm the previously acquired data deletion



- Press the green mark to select gain the trial for data acquisition



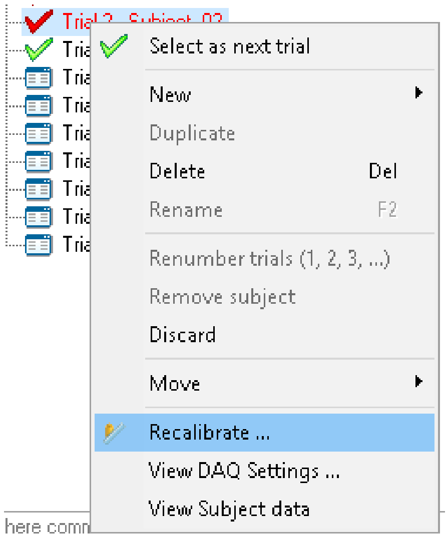
11.2.8. Recalibrating an acquired Trial

The calibration used during the data acquisition of a trial is stored with the trial and is used during analysis. It is possible to change the calibration of registered tracks in case the calibration used during data acquisition was incorrect, however it is recommended, if possible, to discard and acquire the trial again as some detection processes (as TriWise) use the calibration to provide a more reliable tracking.

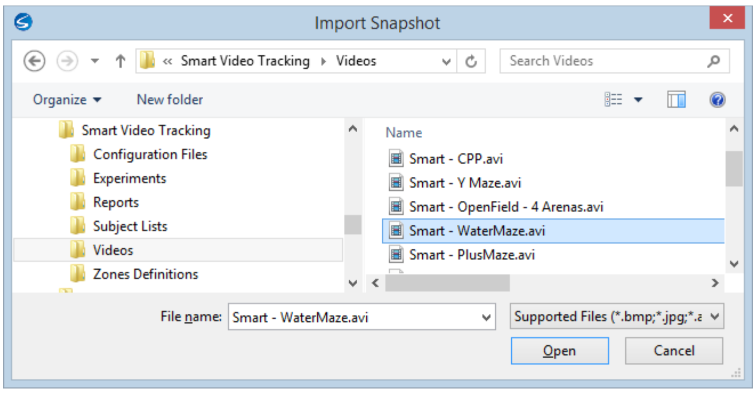
To recalibrate an acquired trial, follow the next steps:

- Select the trial you would like to recalibrate.

- Right-click in the trial and select the **Recalibrate ...** option in the menu

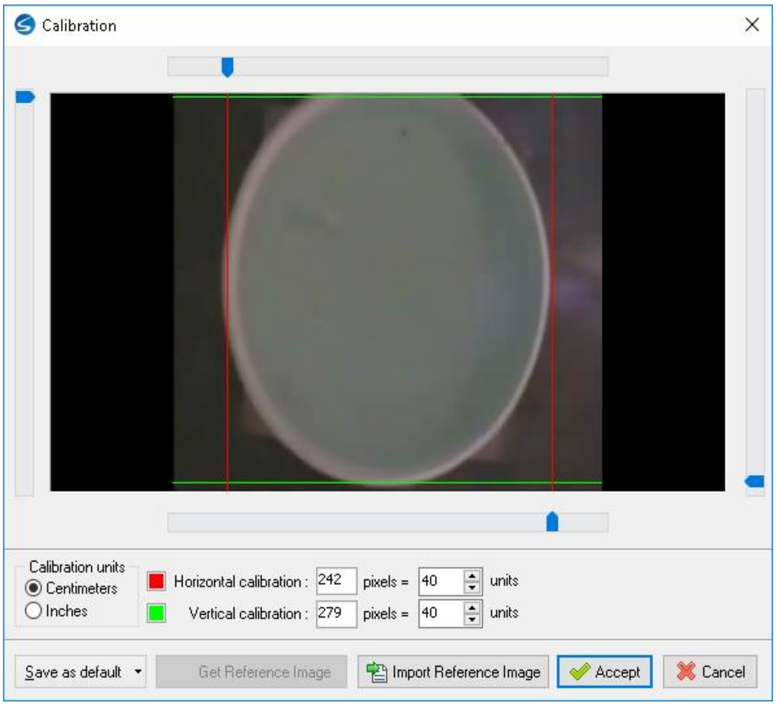


- If the trial has not been stored with a calibration reference image (trials acquired with SMART v3.0.03 or previous), then you will be asked to select a reference image to perform the calibration, else omit this step. It is possible to import a reference image from an image file (.bmp or .jpg) or from a specific frame of a video file.



In case the reference image is to be imported from a video file, the following dialog will allow you to specify the frame to be used. To do so, scroll through the video until the desired image is shown and press the **Accept** button.

- Once a reference image for calibration is available, the calibration dialog is shown. Perform calibration as described in chapter 6.

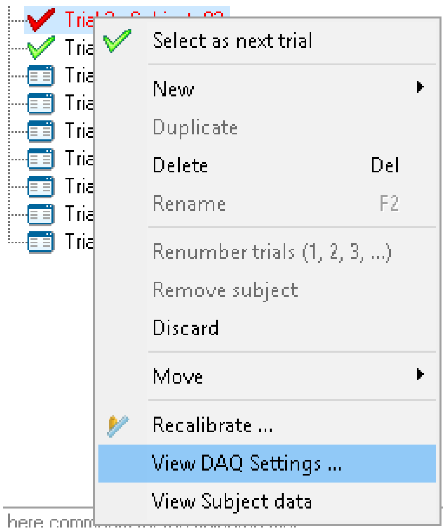


11.2.9. Viewing The Settings Used During DAQ

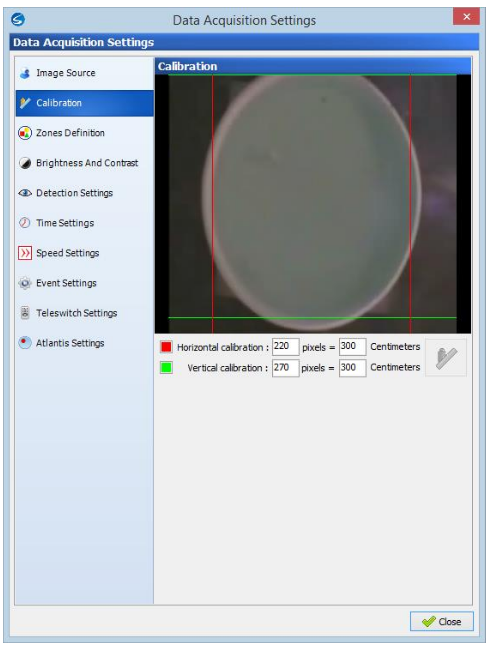
Once a trial has been acquired, it is possible to view all the settings that were used during data acquisition. Follow the next steps:

- Select the trial of which you would like to see its settings.

- Right-click in the trial and select the **View DAQ Settings ...** option in the menu



- A panel will be shown to review the settings used during DAQ of the selected trial.

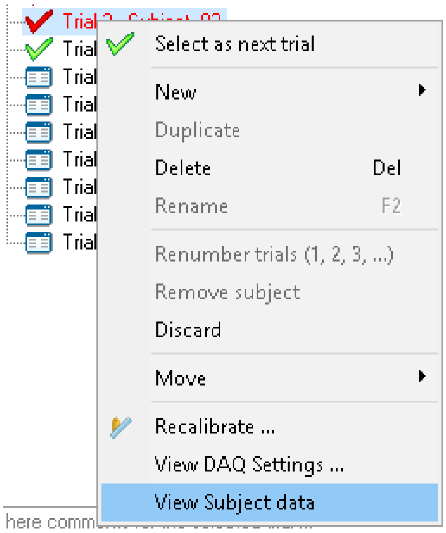


11.2.10. Viewing The SUBJECT DATA

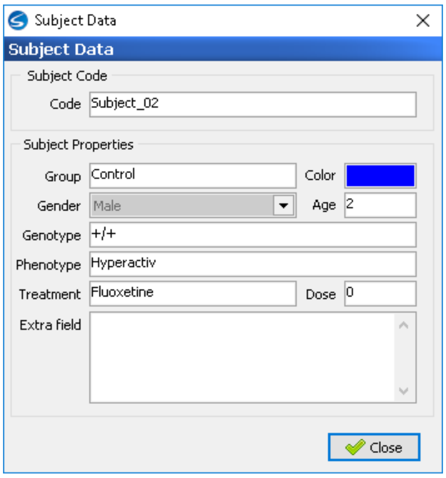
It is possible to view data of the subject assigned to the selected Trial. Follow the next steps:

- Select the trial of which you would like to see its settings.

- Right-click in the trial and select the **View Subject Data** option in the menu.

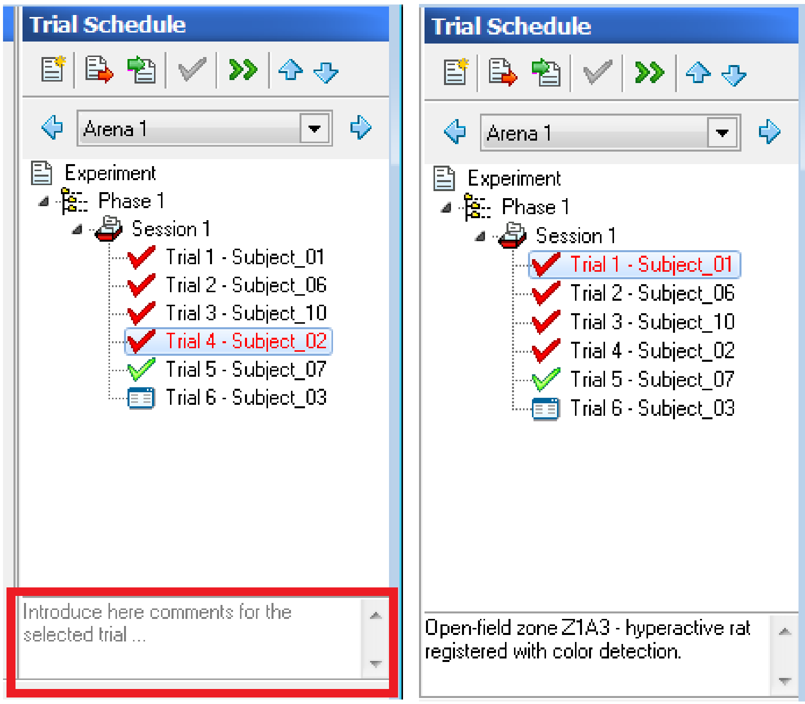


- A panel will be shown to review the data of the Subject assigned to the selected trial.



11.2.11. Trial comments

The Trial Schedule section displays a new section in which the user can write comments about the corresponding trial. The comment can be added, before or after the data acquisition process.



The comments can be retrieved into the data reports generated in Analysis.

11.3. Managing sessions

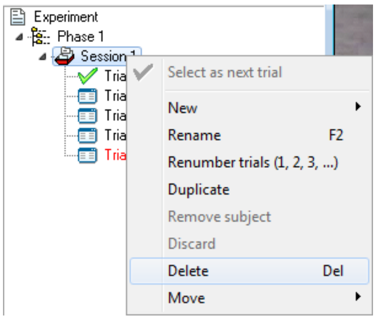
SMART-MA

Although each arena will have its own trials, all arenas will share the same **Phases** and **Sessions**.

This means that adding, renaming or deleting **Phases** or **Sessions** affects all arenas, but adding, editing or deleting trials, only affects the trials associated to the currently selected arena.

11.3.1. Deleting a session

In order to delete a session already defined click on the session's node with the right button of the mouse and select the **Delete** option. Then confirm the deletion message.



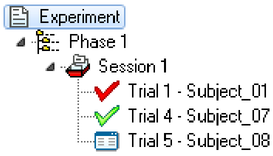
Sessions can be also deleted quickly by using the [DEL] key.

If a session is deleted, the data acquired within the belonging trials will be lost. If the experimental file was saved that information could not be recovered later unless a backup file was previously saved. If a session was unintentionally deleted, DO NOT SAVE the experimental file. Instead, close it and reopen again to recover the information. Other changes done since the last saving will be lost.

A session can only be deleted if all the belonging trials can be removed. Please refer to 11.2.2 for more details on when trials can be deleted.

11.3.2. Renumbering the trials of a session

If some trials are deleted, the numbering sequence of the resting trials within the session can be broken.

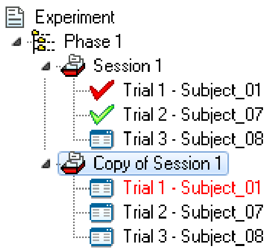


In this example, trials 2 and 3 were deleted so the sequence was broken.

To renumber the trials of the session (to be 1, 2, 3, etc. again), right click with the mouse over the session to be renumbered and select the **Renumber trials** option.

11.3.3. Duplicating a session

Sessions and their planned trials can be easily duplicated. To do so, right click with the mouse over the session's node and select the **Duplicate** option.

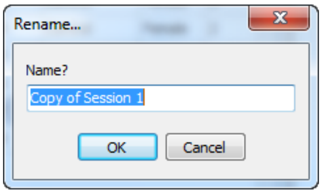


A new session called "Copy of Session X" is automatically inserted at the end of the phase including the same trials and subjects.

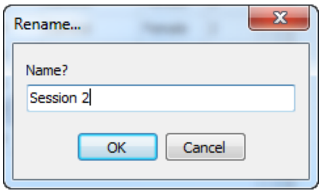
11.3.4. Renaming a session

In order to rename a session:

1. Right click with the mouse over the session's node and select the **Rename** option. The [F2] key can be also used if the session's node is already selected.



2. Enter the new name of the session and press the **Ok** button.



11.3.5. Inserting an empty trial to a session

A new empty trial can be inserted at the end of a session by clicking the session's node with the right button of the mouse and selecting the **New – Trial** option.

11.3.6. Moving the sessions within a phase

Right click with the mouse over the session's node and select the **Move** option. Then select any of the movement options available (Top, Up, Down or Bottom).

The up/down arrow buttons in the **Trial schedule**'s toolbar also facilitates the task of moving the selected session up and down.

When sessions are moved within the phase, the session names are kept. If a session number is being used to keep the sequence, the session name may be manually renamed to accommodate for moved sessions within the phase.

Please note that the sessions cannot be moved out of the phase to which they belong.

11.4. Managing phases

SMART-MA

Although each arena will have its own trials, all arenas will share the same **Phases** and **Sessions**.

This means that adding, renaming or deleting **Phases** or **Sessions** affects all arenas, but adding, editing or deleting trials, only affects the trials associated to the currently selected arena.

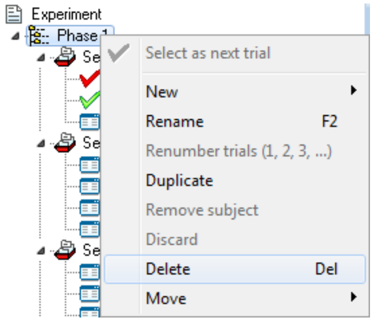
11.4.1. Inserting an empty phase to the experiment

A new empty phase can be inserted at the end of the experimental schedule by clicking the Experiment's node with the right button of the mouse and selecting the **New – Phase** option.

Please refer to the previous chapters for more details on how to insert sessions and trials respectively to the recently created phase.

11.4.2. Deleting a phase

In order to delete a phase already defined right click over the phase's node with the mouse and select the **Delete** option. Then confirm the deletion message.



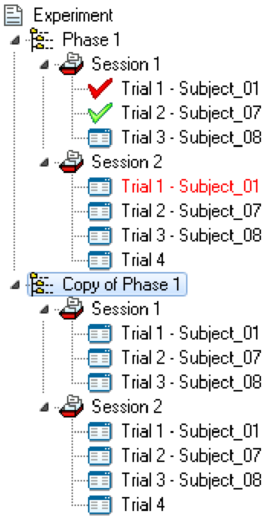
Phases can be also deleted quickly by using the [DEL] key.

If a phase is deleted, the data acquired within the belonging sessions and trials will be lost as well. If the experimental file was saved that information could not be recovered later unless a backup file was previously saved. If a phase was unintentionally deleted, DO NOT SAVE the experimental file. Instead, close it and reopen again to recover the information. Other changes done since the last saving will be lost.

A phase can be deleted only if all the belonging sessions and trials can be removed. Please refer to 11.2.2 and 11.3.1 for more details on when trials and sessions can be deleted.

11.4.3. Duplicating a phase

Phases and their planned sessions and trials can be easily duplicated. To do so, right click over the phase's node and select the **Duplicate** option.

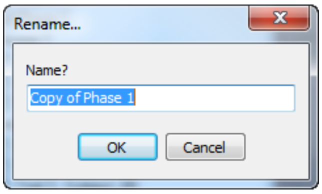


A new phase called "Copy of Phase X" is automatically inserted at the end of the experiment including the same sessions, trials and subjects.

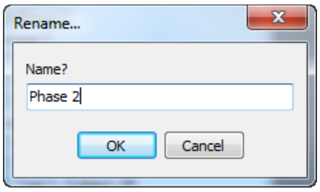
11.4.4. Renaming a phase

In order to rename a phase:

1. Right click with the mouse over the phase's node and select the **Rename** option. The [F2] key can be also used if the phase's node is already selected.



2. Enter the new name of the phase and press the **Ok** button.



11.4.5. Inserting an empty session to a phase

A new empty session can be inserted at the end of a phase by clicking the phase's node with the right button of the mouse and selecting the **New – Session** option.

Please refer to the previous chapters for more details on how to insert new trials on a session.

11.4.6. Moving the phases within the experiment

Right click with the mouse over a phase's node and select the **Move** option. Then select any of the movement options available (Top, Up, Down or Bottom).

The up/down arrow buttons in the **Trial schedule**'s toolbar also facilitates the task of moving the selected phase up and down.

When phases are moved within the experiment, the phase names are kept. If the phase number is being used to keep the sequence, the phase name can manually be renamed.

11.5. Exporting and importing the schedule

The current experiment schedule (**<u>only phases and sessions but not trials nor subjects associated</u>**) can be exported and stored into external files. This operation is very useful if you want to keep a backup of the work done or if you want to share it within a different experimental file.

In order to export the experiment schedule:

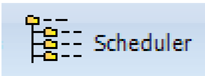
1. Press the **Export** button located in the **Trial Schedule**'s toolbar of the panel.
2. Enter the name of the exported scheduler file and press the **Save** button.

Exported scheduler files are stored by default within the "Subject list" folder configured and with the extension SMS (SMART Schedule). Please refer to the chapter 12.1 for more details on how to configure the default destination folders.

Exported scheduler files (remember, only phases and sessions but not trials nor subjects associated) can be imported later into the same experimental file or into a different experimental file.

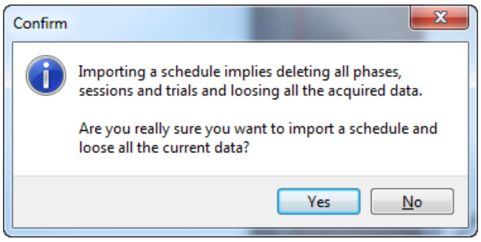
In order to import a previously exported experimental schedule:

1. Open the experimental file in which the schedule is to be imported.



2. Access the **Scheduler** manager.

3. Press the **Import schedule** button.
4. Locate the folder and file in which the scheduler file is stored. The press the **Open** button.

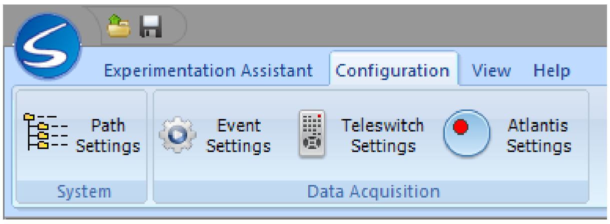


5. Accept the confirmation message if you want to delete all the existing phases, sessions and trials (this will result in losing all the acquired data thus far).

   The current schedule is automatically applied to the experiment, removing all the existing phases, sessions and trials. However, the experimental subject list is kept.

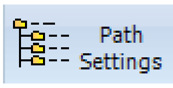
12. Additional configuration

The **Configuration** menu of the SMART main window provides you with additional tools to configure the system to your particular needs.

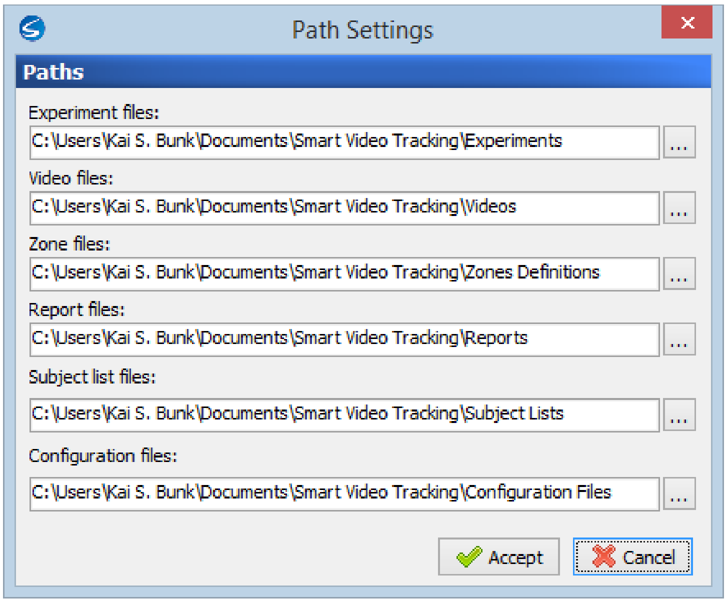


12.1. Path settings

By default, SMART automatically stores the generated files in the **Documents** folder of the user. The default paths can be easily configured through the **Path Settings** panel. To do so:



1. Press the **Path Settings** button.



2. Press the ... button associated to each of the configurable folders.
3. Locate and select the desired folder.

4. Press **Accept** button.

12.2. Teleswitch settings

Teleswitch unit allows for remote control using the radiofrequency technique for controlling the start and stop of the session without the computer. It is especially useful when the experimental protocol requires the track acquisition process to start at the same time the subject is placed into the experimental area. The remote start of the session in this context can be then achieved using the Teleswitch unit.

12.2.1. Connecting the Teleswitch

The Teleswitch unit is composed of a remote control unit and a small USB wireless adapter device.

Before connecting the Teleswitch unit to the computer, make sure to install the battery (included) in the back of the unit:

Version 1	Version 2
	

Now remove the USB receiver from the back of the unit and plug it into a free USB 2.0 port in your computer.

Version 1	Version 2
	

The recommended distance between the Teleswitch unit and the USB receiver plugged into the computer is 10 meters without any obstacle.

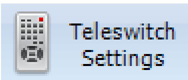
An additional USB extension cable is provided to facilitate installing the USB receiver in a position in which the visibility is improved.

If needed, plug one side of the USB extension cable into the free USB port in your computer and the USB receiver into the other side of the cable. Then put the USB receiver in a stable position without any obstacle between it and the Teleswitch unit.

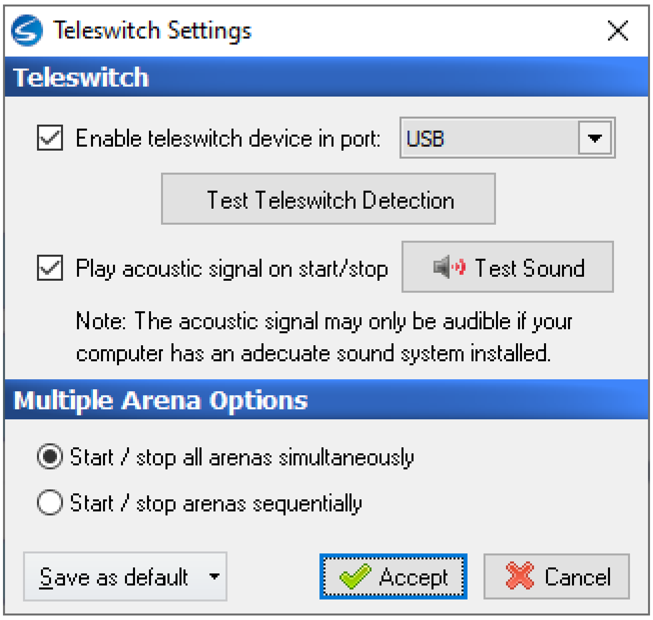
Now wait for Microsoft® Windows® to automatically detect and install the new device.

Old serial Teleswitch units provided with SMART v2.5 are also compatible with SMART v3.0. Please refer to the SMART v2.5 User's Manual for more details on how to connect the device to your computer.

12.2.2. Configuring the Teleswitch



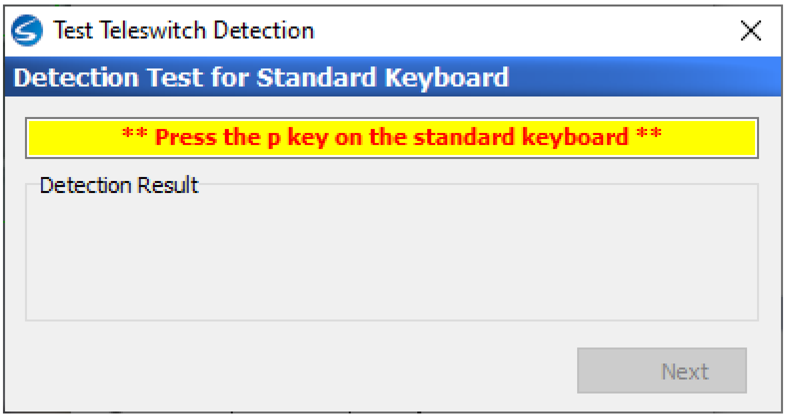
1. Press the **Teleswitch Settings** button.

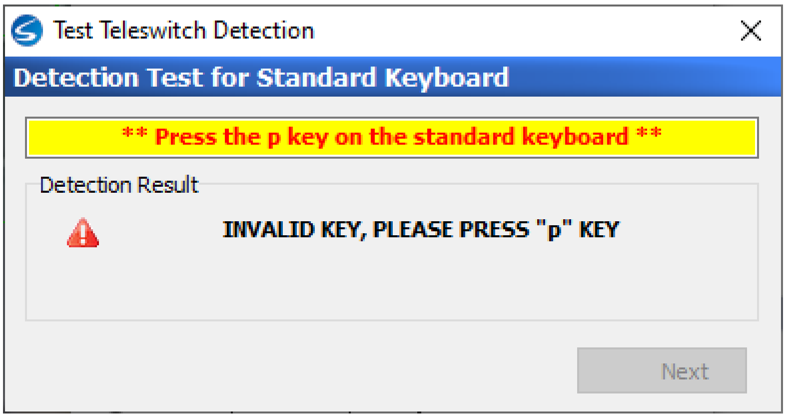


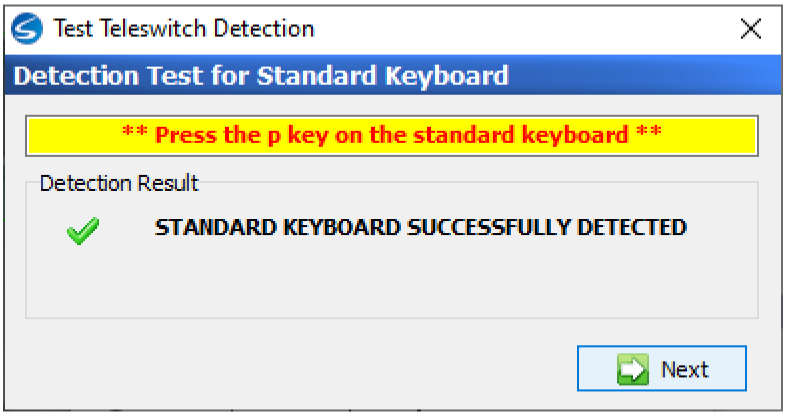
2. Check the box **Enable Teleswitch device in port** if you want to enable the Teleswitch device.
3. Select the communication port in which your Teleswitch device is connected. By default, a USB port is suggested but old models can be also connected to any of the COM ports available in the computer.

4. Click button **Test Teleswitch Detection** to open the assistant that allows testing the Teleswitch detection and registering the device. The assistant consists of two steps:

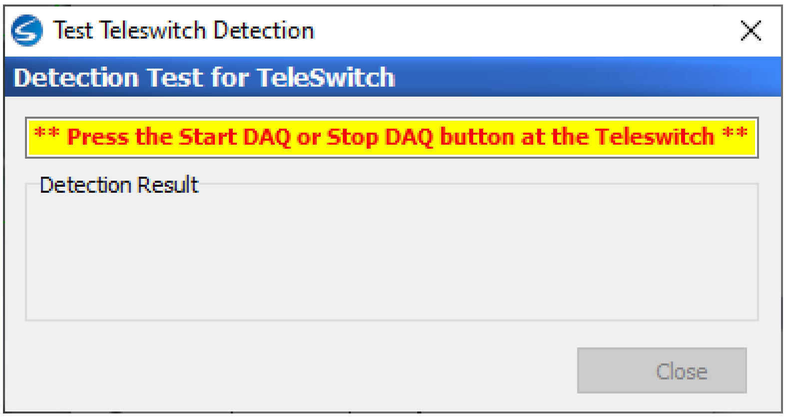
   a. The first step requests to press the key for letter "p" at the standard keyboard.







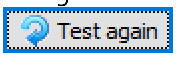
   b. The second step requests to press the key defined for Start DAQ or Stop DAQ at the Teleswitch (Please refer to the chapter 12.2.3. for detailed information of the keys used in different Teleswitch versions).


Test Teleswitch Detection
Detection Test for TeleSwitch
** Press the Start DAQ or Stop DAQ button at the Teleswitch **
Detection Result
Close

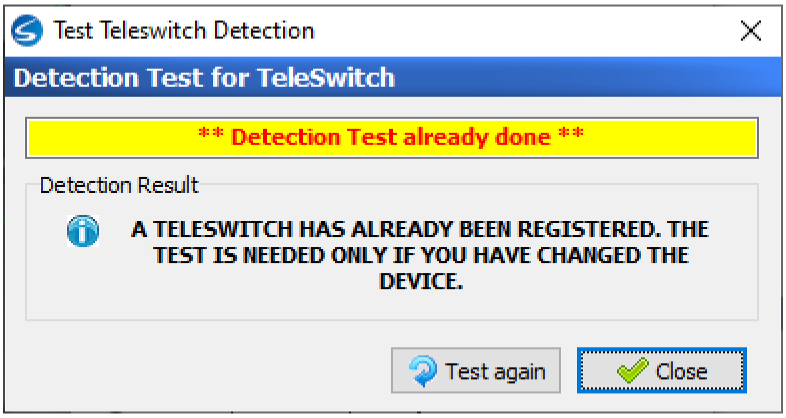

Test Teleswitch Detection
Detection Test for TeleSwitch
** Press the Start DAQ or Stop DAQ button at the Teleswitch **
Detection Result
INVALID KEY, PLEASE PRESS THE KEY FOR START OR STOP DAQ
Close


Test Teleswitch Detection
Detection Test for TeleSwitch
** Press the Start DAQ or Stop DAQ button at the Teleswitch **
Detection Result
TELESWITCH SUCCESSFULLY DETECTED AND REGISTERED
Close

c. The identifier of the standard keyboard must be different of the identifier of the Teleswitch; otherwise, an error message is shown and the device is not accepted.

d. Once a Teleswitch was detected and registered, it is possible to change the device by a different one. To do that, click in button 

and repeat the previous steps.



Execution of this detection test is required if the Teleswitch has been enabled.

5. Check the box **Play acoustic signal on start/stop** to make the computer play an acoustic signal (beep) whenever the trial starts or stops using the Teleswitch unit.

The **Test Sound** button will allow you to test the sound playing before starting any trial.

This useful tool will help you to make sure that the Teleswitch unit is working fine but may affect the answer of the subjects. Please check this box only if it does not affect within your specific experimental conditions.

The acoustic signal is played by means of the sound system of your computer so please make sure the sound card and the speakers are properly installed and turned on.

6. To make the Teleswitch settings available for new experiments, use option Save as Default.

12.2.3. Starting and stopping trials with the Teleswitch

Data acquisition sessions (trials) can be started and stopped by means of the correponding buttons of the Teleswitch unit as indicated:

Version 1	Version 2
	

Please be aware that if you press the "Close Window" key in the Version 2 of Teleswitch device, the close action will be executed over the active window/panel with unpredictable results.

SMART-MA

SMART-MA users are provided with a specific section within the **Teleswitch Settings** panel called **Multiple Arena Options**.

The available options allow defining the behavior of SMART when the START and STOP buttons are used during the data acquisition of multiple arena experiments.

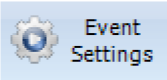
- Start / Stop all arenas simultaneously: Use this option if you want to ask SMART to start or stop all arenas at the same time when the buttons in the Teleswitch device are pressed.

- Start / Stop arenas sequentially: Use this option if you want to ask SMART to start the arenas starting by the arena 1, then arena 2 and so on.

  The same applies to stop the arenas (the first arena to be stopped is the arena 1 but, if it is already stopped, then the arena 2 is stopped and so on).

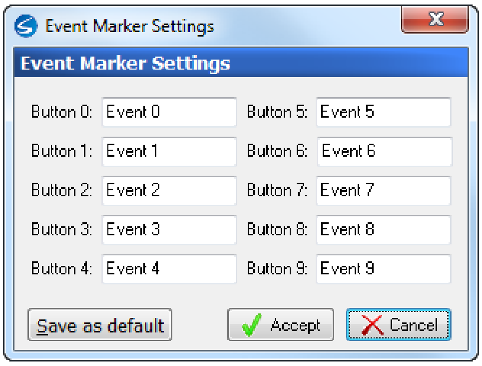
Please remember that the data acquisition process can only be started if a valid protection key is plugged in or if the trial period has not expired yet.

12.3. Event marker settings



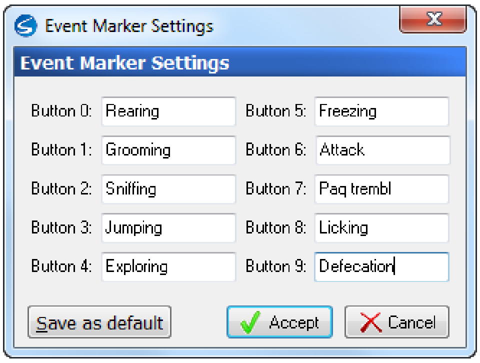
The event marker is an ethological keyboard that allows the manual recording of specific behaviors visualized and recognized by the user. Events are marked by a keystroke on the keyboard.

The first step in using the event marker is to define which code will be associated to each event to be recorded. The **Event Settings** panel is available from the **Configuration** menu.

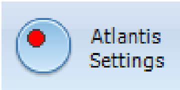


If no code has been defined, SMART will take "Event 0" (zero) as the default for naming the first event, "Event 1" for the second and so on. In this case, this text will appear on the screen and whenever the event file is hard-copied.

It is possible to define an associated text (name) related to each one of the events under study. Setting up the Event Marker is as simple as naming the events of interest. An example is given below.



A maximum of 10 different events can be defined.



12.4. Atlantis Settings

SMART-CS

The Atlantis platform is an automated island for Morris Water Maze Test. SMART-CS module enables SMART to control the Atlantis platform manually or automatically.

The rest of this chapter only applies to SMART-CS users.

SMART-MA

SMART is able to control one Atlantis platform for each one of the defined arenas. Thus, the Atlantis platform settings can be defined for each arena differently.

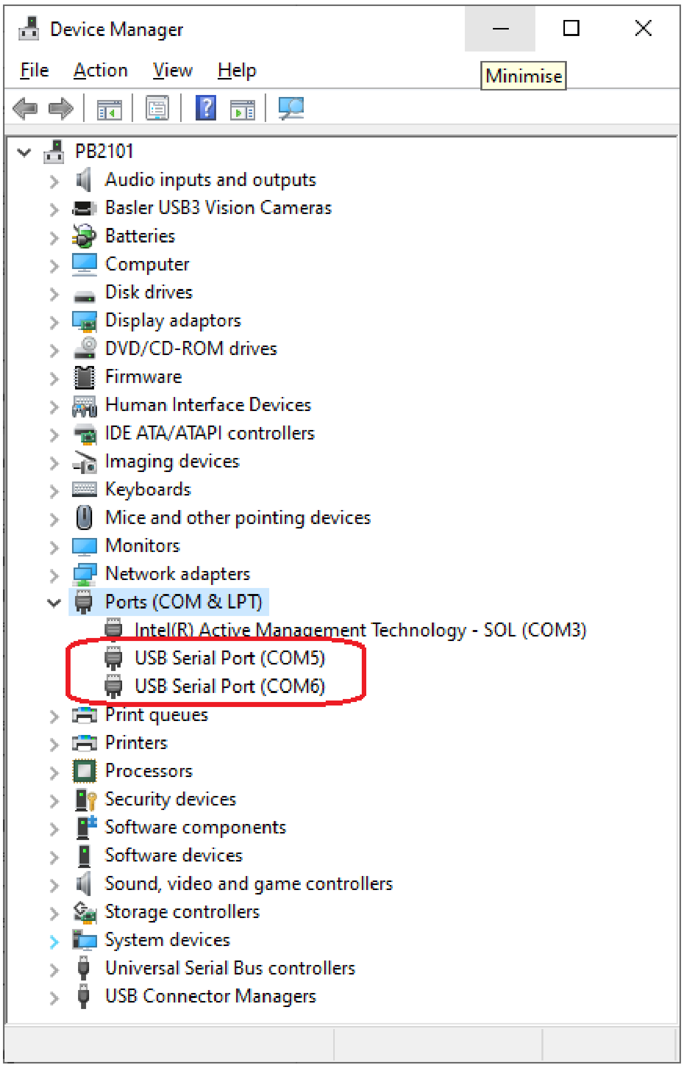
12.4.1. Connecting the Atlantis platform

Atlantis platform requires the use of a RS232/USB adapter that is needed for converting a USB port to a serial port valid for communications between hardware and software.

We recommend the use of a specific model of converter: CONRS232USB-HS (USB2-H1002). We cannot guarantee a correct functioning of the system with any other USB-serial converter. The converter allows the use of two serial ports in your PC or laptop, and it includes an extension cable just in case.

To install the converter:

1. Connect the converter to the computer.
2. Windows 8, 10 and 11 will automatically install the drivers.
3. If working with a Windows 7 or inferior, please refer to the notice provided in the box of the converter.
4. Once connected and installed, two serial ports will appear into the [Device Manager] window on the Windows Operative System. Usually, the numbers assigned by Windows are sequential.

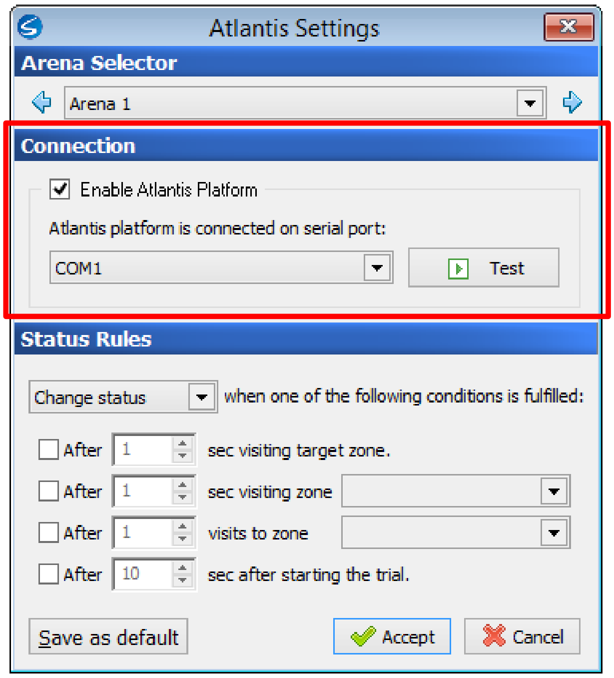

Device Manager
Minimise
File
Action
View
Help
PB2101
Audio inputs and outputs
Basler USB3 Vision Cameras
Batteries
Computer
Disk drives
Display adaptors
DVD/CD-ROM drives
Firmware
Human Interface Devices
IDE ATA/ATAPI controllers
Imaging devices
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Ports (COM & LPT)
Intel(R) Active Management Technology - SOL (COM3)
USB Serial Port (COM5)
USB Serial Port (COM6)
Print queues
Printers
Processors
Security devices
Software components
Software devices
Sound, video and game controllers
Storage controllers
System devices
Universal Serial Bus controllers
USB Connector Managers

In case it is not possible to connect the PC or Laptop to internet, please execute the following steps:

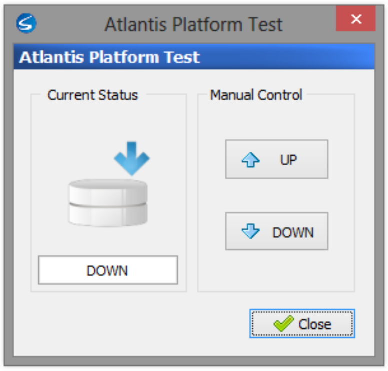
1. Insert the SMART software USB flash key into a free USB port of your computer, access its content and execute the installation assistant (Panlab.exe).
2. The following installation window will be shown.

3. Enter the **"Atlantis Platform -> RS232-USB Adapter Drivers"** folder and execute the exe file in it. Accept the warning to allow the installer to make changes in the computer and follow the installer steps, accepting the agreement when it is presented. After finishing it, connect the converter to the computer and check that two serial ports appear into the [Device Manager] window on the Windows Operative System.

Once the Atlantis platform is connected to the computer, use the **Atlantis Settings** panel to establish the COM port where the Atlantis platform is connected. The **Atlantis Settings** panel is available from the **Configuration** menu.

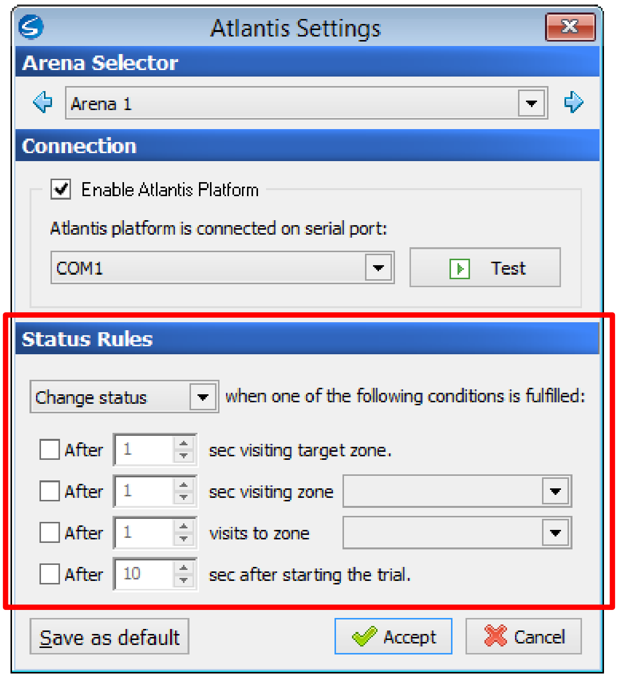


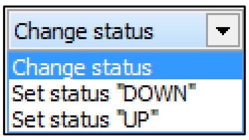
It is possible to test the connection to the Atlantis platform by using the **Atlantis Platform Test** panel that can be accessed by the **Test** button.



12.4.2. Automatic control of the Atlantis platform

SMART is able to change the status of the Atlantis platform automatically during the data acquisition of a trial. The conditions to change the status of the Atlantis platform can be established in the **Atlantis Settings** panel which is available from the **Configuration** menu.



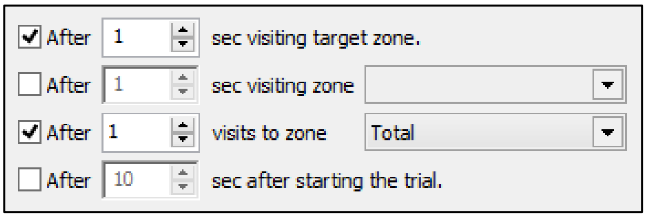


First, an action must be selected that will be executed when one of the conditions defined later are fulfilled. Three different actions can be performed:

- Change the status of the platform regardless of which position it is currently. If the platform is up, then it will be lowered or if the platform is down, then it will be raised.
- Lower the platform if it is up.

- Raise the platform if it is down.

Next, the conditions to perform the action previously selected have to be defined. For a condition to be considered its corresponding checkbox must be checked and its parameters (if any) must be established.



The following conditions to change the status of the Atlantis platform are available:

- **After <x> sec visiting a target zone**

  The status of the Atlantis platform changes automatically when the subject has spent a user-defined consecutive time (x sec) in a zone defined as Target.

  Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

- **After <x> sec visiting zone <z>**

  The status of the Atlantis platform changes automatically when the subject has spent a user-defined consecutive time (x sec) in a user-selected zone (z).

  Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

- **After <x> visits to zone <z>**

  The status of the Atlantis platform changes automatically after a user-defined number of visits (*x*) into a user-selected zone (z).

  Please note that zone visits are considered *only* when the **Track Detection** option is enabled. Please refer to chapter 8.2 for more information on the detection modes.

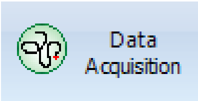
- **After <x> sec after starting the trial**

  The status of the Atlantis platform changes automatically after a user-defined time (x sec) has passed since the start of the data acquisition of a trial.

It is always possible to manually change the status of the platform during the data acquisition process using the **Atlantis Platform Control** panel described in chapter 13.6.

13. Data acquisition

13.1. Entering the data acquisition mode



Once the experiment has been configured following the instructions given in the previous chapters, data acquisition mode is available by means of the **Data Acquisition** button in the **Experimentation Assistant** bar.

The data acquisition process is closely related to the calibration of the system. The first time the data acquisition mode is accessed, SMART checks whether the calibration was done. In case that no calibration was done, a warning message is shown preventing you to acquire data without calibrating the system.

It is strongly recommended to check the calibration of the system several times along the working day as that information is critical for the further calculations and cannot be modified once the trials are acquired.

Please refer to the chapter 6 for more information on how to calibrate the system properly.

If the calibration was done, SMART enters the data acquisition mode and shows the two main panels called **Runtime Viewer** and **Time Control**.

13.2. Player view

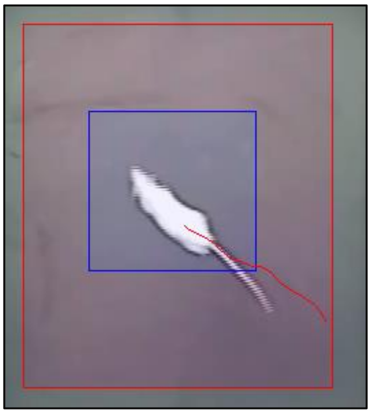
The player view allows the only checking of animal detection. Depending of the SMART modules and Extension used some additional visual effects are shown in this panel.

The tools provided in the player are the same as the ones described in Chapter 5.1.

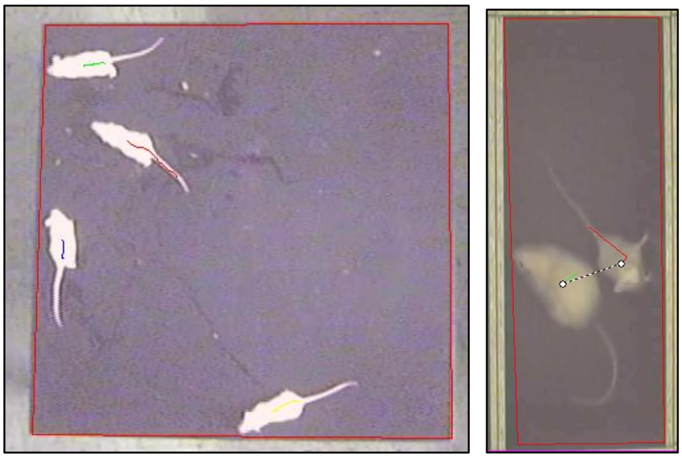
- Arena name tag viewer
- Zone definition viewer
- Zone opacity tool
- Subject name and coordinate tag viewer
- Video zoom

13.2.1. Center of mass tracking

- The subject track is marked with a red line following the center of mass of the subject under trial.

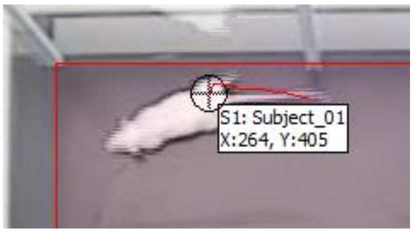


- When tracking several animals in the same trial, a track line is assigned to each subject (the color of each tracking line is assigned randomly by the system). A dotted line appears when a contact is detected between the centers of mass of the subjects.

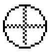
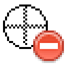


13.2.2. Manual tracking

- The subject track is marked with a red line following the cursor position as indicated by the user.

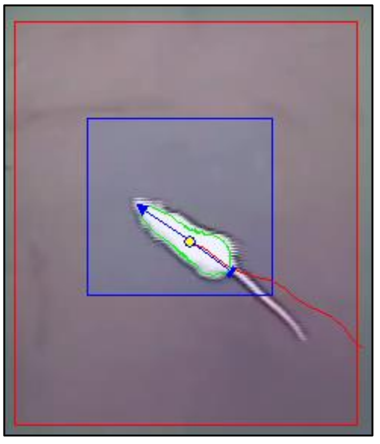


- The icon of the cursor will show whether the position of the cursor within the player is valid or not. The position if the cursor is valid only when it is within an arena.

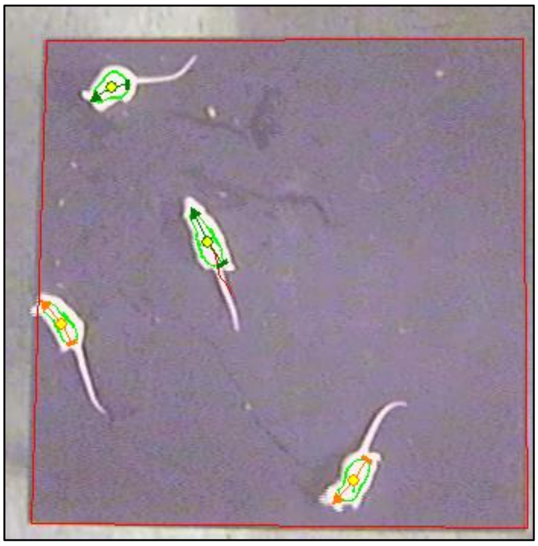
Valid:  Invalid: 

13.2.3. TriWise tracking (SMART-TW)

- The subject track is marked with a red line following the center of mass of the subject.
- An arrow is shown indicating the direction of the animal body and the position of the head (triangular extremity), the center (circle) and the base tail (short line extremity)
- A green line is also used for indicating the shape of the dot of pixel detected for each animal and visualized during the Detection test (see chapter 8.2.3.4)

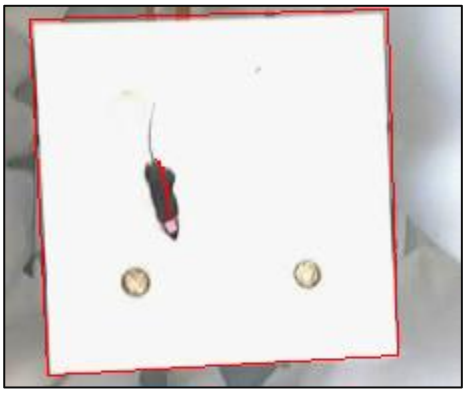


- When working with multiple subject animals in the same experimental area because using the SMART-SI social interaction module, each animal is marked with an individual arrow representation. The color of the arrow depends on the color property selected for the subject in the Subject Data Base. To be reflected into the player, the color selection has to be made before the animal is assigned to the trial. A dotted line appears when a contact is detected between the points selected by the user (can be head-head, center-center, head-tail, etc.) .

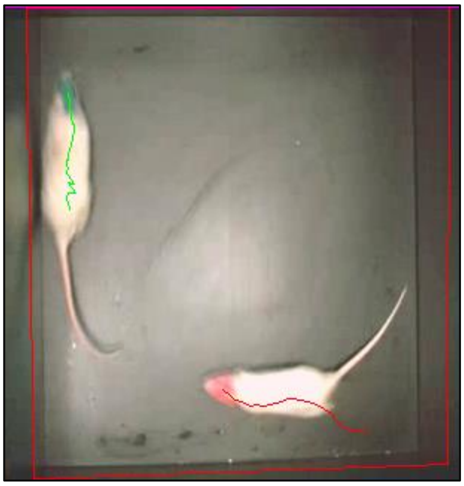


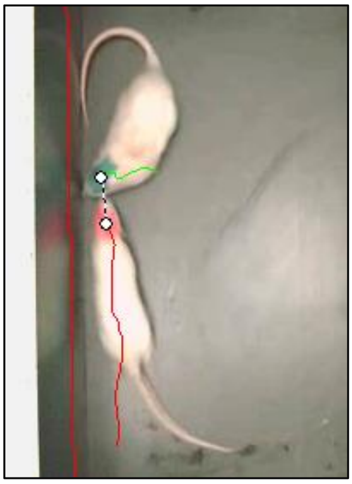
13.2.4. Color tracking (SMART-TW)

- The subject track is marked with a colored line following the center of mass of the detected dot of color.



- When tracking several animals in the same trial (SMART-SI), a track line is assigned to each subject. The color of the line is the color selected by the user to be detected in the color tracking detection settings. A dotted line appears when a contact is detected between the colored dots.





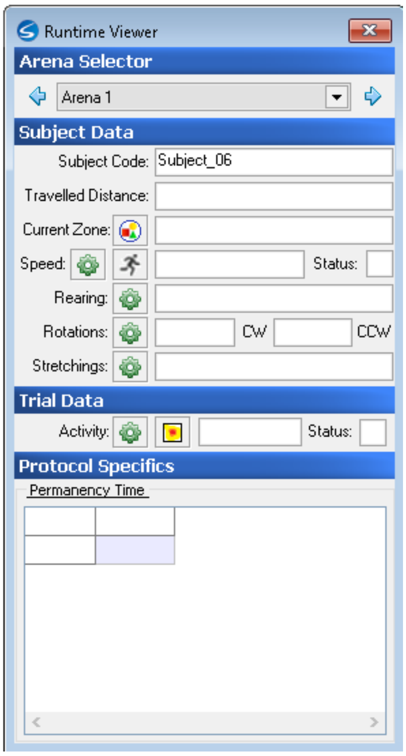
13.3. The Runtime Viewer panel

This panel shows all the protocol-relevant data calculated during the running of the trial divided into two sections:

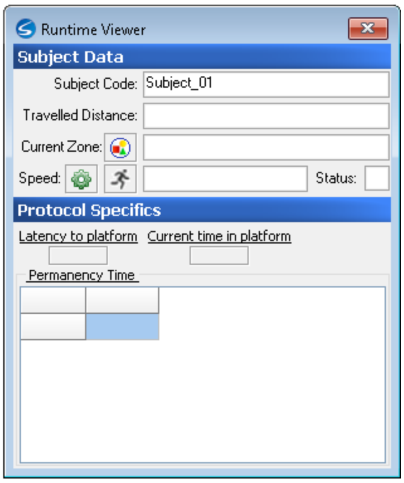
- Subject data: such as current subject, zone occupied and speed.
- Protocol specifics data: depends on the selected protocol.

SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Runtime Viewer** panel. Select the arena (with the selector or clicking directly at the **Player** panel) to review its runtime information.



Runtime Viewer with all the extensions licensed



Runtime Viewer for SMART-WM module (no extensions licensed)

As in other functionalities, the **Runtime Viewer** panel is automatically adapted to the enabled extensions, the selected experimental module and the settings done within the **Detection Settings** panel.

If a finished trial is selected in the **Schedule** panel, the **Runtime Viewer** panel is adapted to the settings used and the modules/extensions licensed during the acquisition of that trial, independently on whether the extensions or modules are presently available or not.

13.3.1. Subject data

The following information is provided in the runtime panel depending of the Detection mode used.

13.3.1.1. Center of Mass tracking detection mode

Subject Code

The Subject code is the name of the subject assigned to the trial (can be the next or the finished trial selected in the **Schedule** panel).

Travelled distance

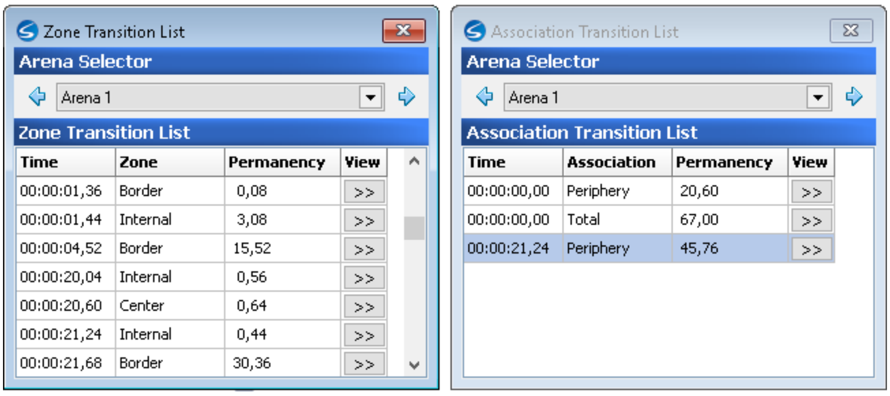
The travelled distance is the current distance covered by the subject.

Current zone and transition lists

The current zone displays the name of the current zone in which the subject is detected (or the name of the last zone occupied in the trial selected in the **Schedule** panel).

The button shows the **Transition Lists** panels:

The Transition Lists panels are a useful tool that logs all the zone and zone association transitions made by the subject.



SMART-MA

An "Arena selector" control is provided for SMART-MA users within each one of the **Transition Lists** panels. Select the arena (with the selector or clicking directly at the **Player** panel) to review the list of zone/zone association transitions made by the subject specifically in that arena.

Each **Transition List** is arranged as a table in which each row represents a zone/zone association entry. Each row holds the information of occurrence time, entry zone/zone association and permanence time.

The **Transition Lists** are automatically calculated and updated during the execution of the trial and can be reviewed once the trial has finished.

If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided to "replay" each transition in the **Player** panel. Press the **Stop** button on the **Digital Video Control** panel to stop the video again.

Current speed

The speed is the current speed of the subject taking into account the sample points of the corresponding registered tracking (measured in the units specified during the calibration, cm/s or inch/s).

Displacement pattern

The speed status field represents the current subject displacement pattern status calculated depending on the speed thresholds adjusted in the **Speed Settings** panel:

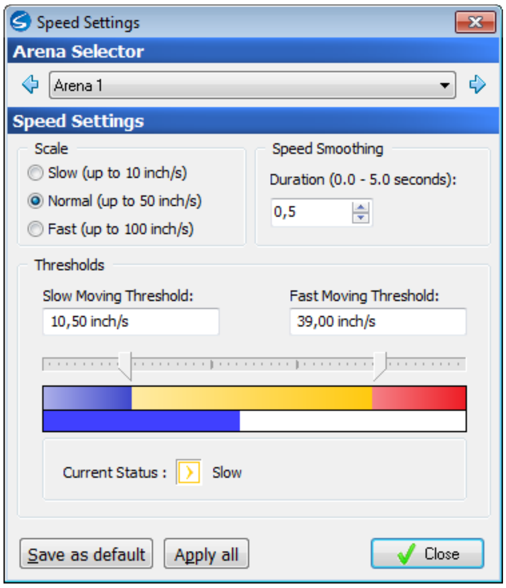
 Represents a RESTING status.

 Represents a SLOW displacement status.

 Represents a FAST displacement status.

Speed Settings

The button  displays the **Speed Settings** panel for settings the speed thresholds.



SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Speed Settings** panel to adjust the speed thresholds for each arena independently.

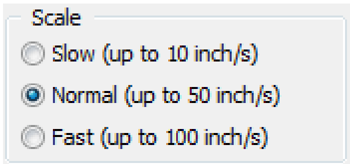
Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

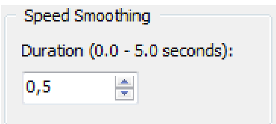
Three parameters are configurable. The value of each one depends on variables such as the subject size and motor capabilities of the animal strain used:

<u>Speed scale</u>

Allows selecting the maximum speed (in the units used during the calibration process) the animal can reach:



<u>Speed Smoothing</u>



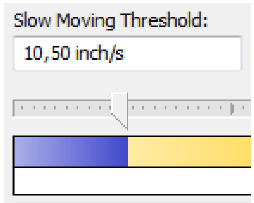
A period of time (in sec) in which the speed is averaged before determining the punctual speed. This option minimizes the impact that the artifacts in the image can produce on the speed calculations.

A default value of 0.5 sec is configured. This value is suitable in most cases but you can adjust it between 0 sec (no smoothing applied; the current speed is exactly the punctual speed) and 5 sec (the punctual speed during the last 5 sec is averaged to calculate the current speed).

Speed Thresholds

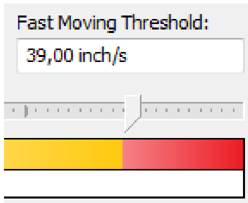
- **Slow moving (resting) threshold**:

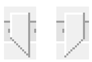
  Threshold under which the animal is deemed "immobile".



- **Fast moving threshold**:

  Threshold above which the animal is deemed to be "moving fast".





The thresholds can be adjusted by dragging the markers along the horizontal rule.

A fine adjustment can be achieved by clicking the rule and using the following combination of key strokes:

- [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "Slow Moving Threshold".
- [CTRL] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "Fast Moving Threshold".
- [SHIFT] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease both thresholds at the same time.

SMART allows changing the values of the thresholds during the tracking as well in order to facilitate the choice of their values depending of the criterion of the user.

The values chosen during the detection test and during the acquisition process can be changed afterward during the analysis process for obtaining a new set of data.

The entire track to which the values of the thresholds have been changed during the tracking process should be reanalyzed again in **Analysis** mode with the final threshold selections.

To generate a statistically relevant data set, it is recommended to use the same threshold for all the subjects within the experiment to compare the data between the different experimental groups.

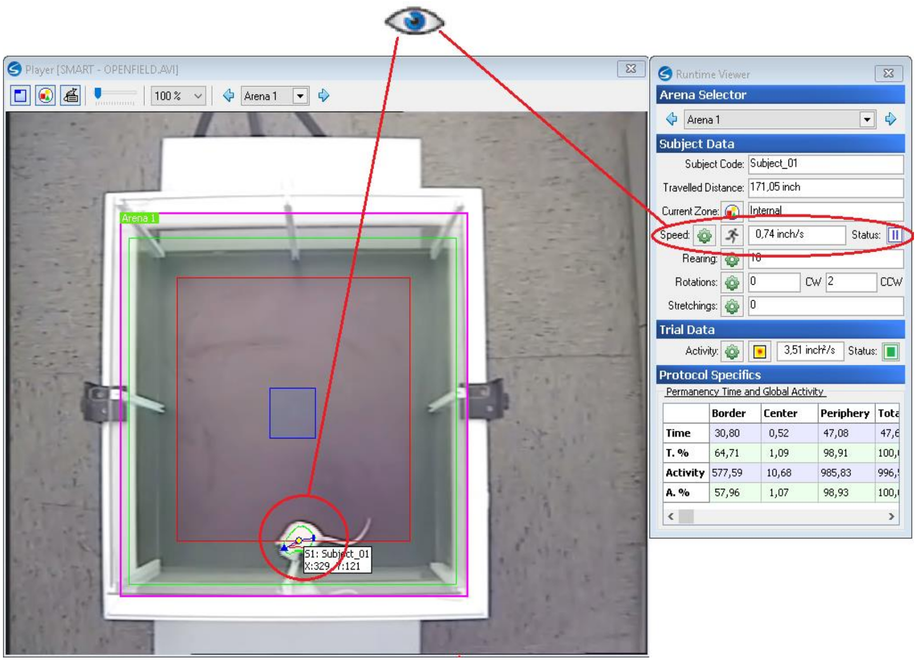
The following are some recommendations for setting the speed thresholds properly:

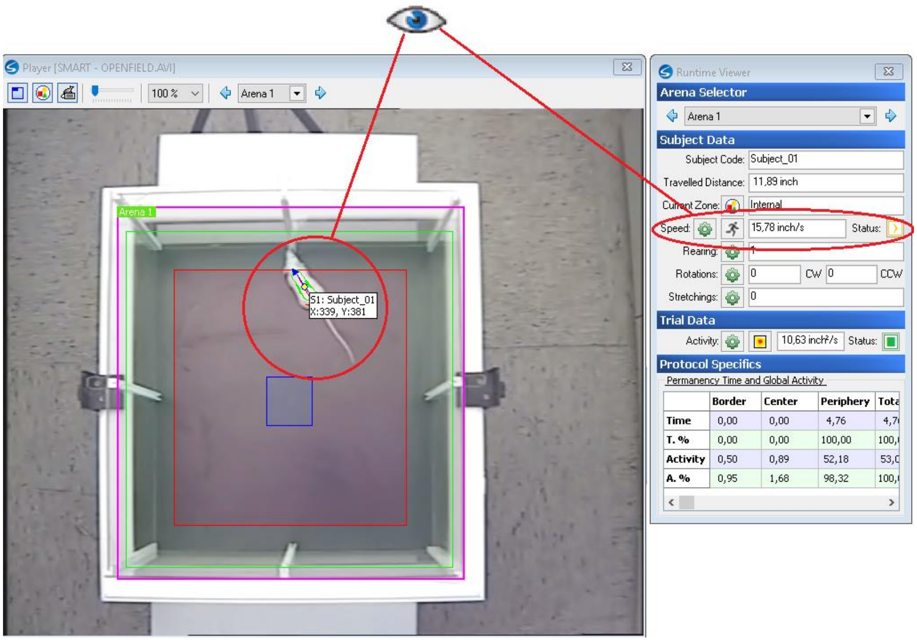
- The speed thresholds are to be determined by the user using a pilot subject having the same characteristics than the ones that will be used during the experiment.

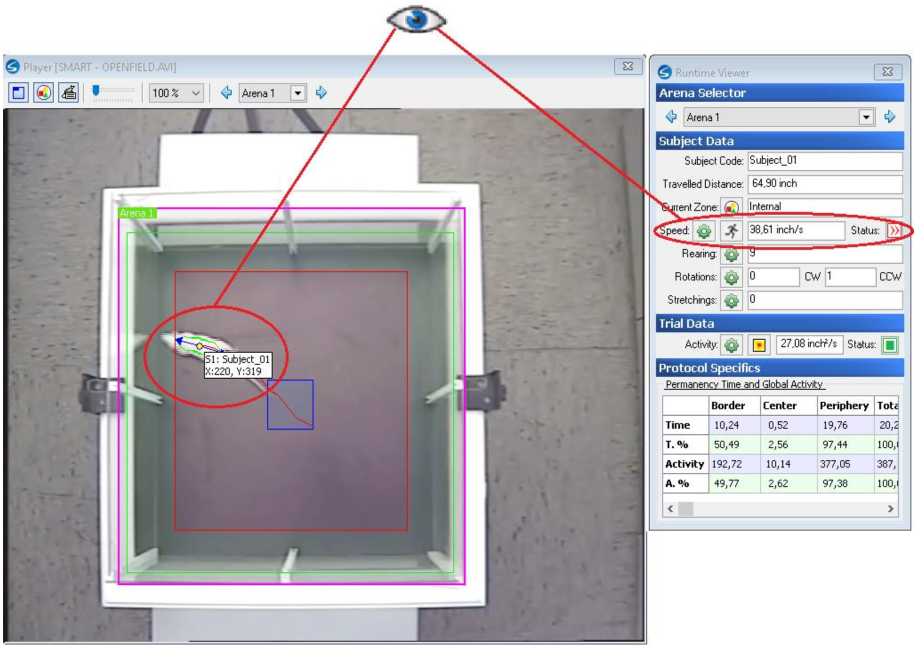
- Use the detection test mode or a test trial with the pilot animal in the same conditions in which the experiment will be performed.

- Look at the behavior of the animal. At the same time, look at the range of current speed displayed by SMART each time you consider the animal as immobile (resting), moving slow or moving fast.

In the example below, the mouse was considered as "resting" when the current speed was always below 10 inch/s. The mouse was considered "moving slowly" when the range of the current speed was equal or greater than 10 and lower than 35 inch/s. Finally, the mouse was considered "moving fast" when the speed was equal or greater than 35 inch/s.

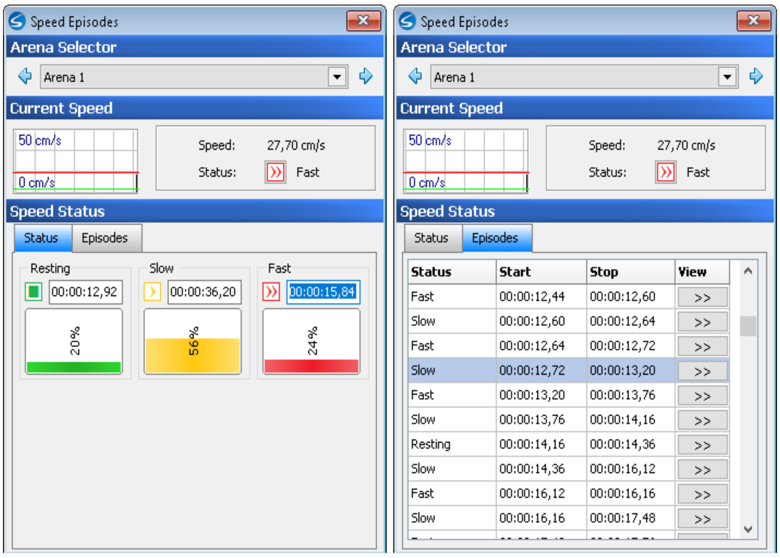



Player [SMART - OPENFIELD.AVI]
100 %
Arena 1
S1: Subject_01
X:339, Y:381
Runtime Viewer
Arena Selector
Arena 1
Subject Data
Subject Code: Subject_01
Travelled Distance: 11,89 inch
Current Zone: Internal
Speed: 15,78 inch/s Status:
Rearing: 1
Rotations: 0 CW 0 CCW
Stretchings: 0
Trial Data
Activity: 10,63 inch²/s Status:
Protocol Specifics
Permanency Time and Global Activity


Player [SMART - OPENFIELD.AVI]
100 %
Arena 1
S1: Subject_01
X:220, Y:319
Runtime Viewer
Arena Selector
Arena 1
Subject Data
Subject Code: Subject_01
Travelled Distance: 64,90 inch
Current Zone: Internal
Speed: 38,61 inch/s Status:
Rearing: 9
Rotations: 0 CW 1 CCW
Stretchings: 0
Trial Data
Activity: 27,08 inch²/s Status:
Protocol Specifics
Permanency Time and Global Activity

Speed Episodes Details

The **Speed Episodes Details** panel can be accessed through the button associated to the **Speed** field in the **Runtime Viewer** panel. This panel shows additional information about the subject displacement pattern, such as the time the subject has been in the different speed pattern and the list of speed episodes.



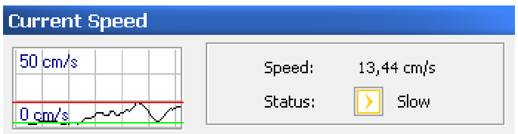
SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Speed Episodes Details** panel to review the speed episodes details for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

Current speed

This section shows the current speed and the current speed status. The scope shows the speed throughout time and the current speed threshold values.



The speed status field represents the current subject displacement pattern status calculated depending on the speed thresholds adjusted in the **Speed Settings** panel:

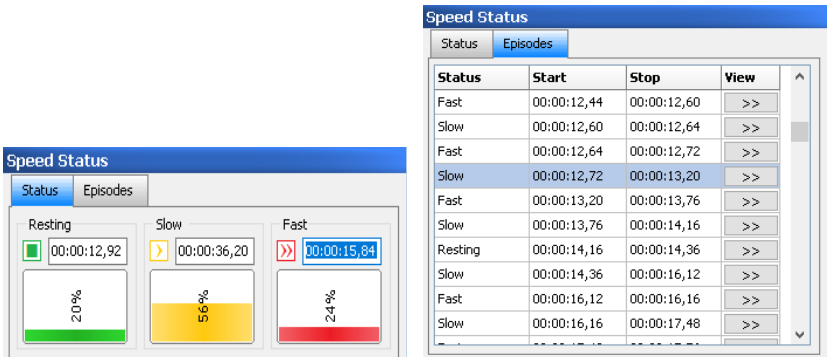
Represents a RESTING status.

Represents a SLOW displacement status.

Represents a FAST displacement status.

Speed status

This section shows the time and its percentage that the subject has been in the different displacement pattern status. A table shows the history of all the different speed episodes throughout the trial.

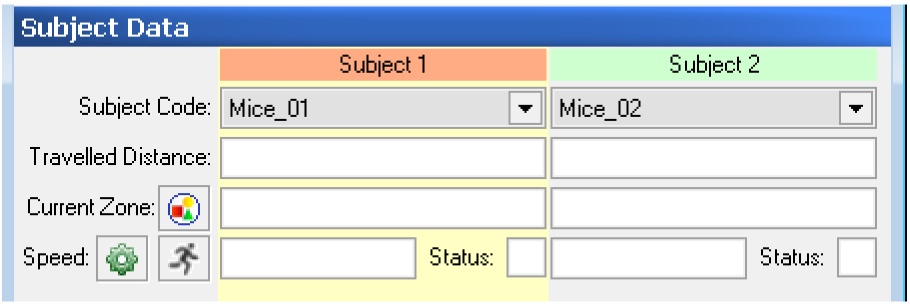


>>

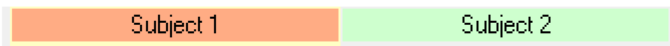
If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided to "replay" each change on the speed status in the **Player** panel.

Multiple subject consideration (SMART-SI)

When using the SMART-SI social interaction module, the Subject data panel proved the current data for each of the subject assigned to the same trial.



The system will provide an internal label to each animal (Subject 1 to Subject n) in addition to the user-defined name.



The user can select a subject (highlighted in orange color) for the visualization its individual runtime data panel (zone transition table, etc....).

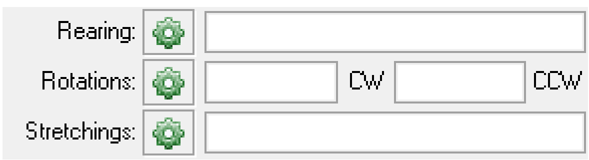
The user can choose which subject of the trial will be associated with each internal label by choosing the animal for the available list.

The same subject cannot be associated with two different labels. The data of the trial will be registered with the last associations between internal label and user-defined name of the subject until the trial ends.

13.3.1.2.3-point triwise tracking detection mode (SMART-TW)

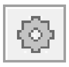
When using the 3-point TriWise detection mode additional Subject data are provided additionally to the one proposed when using the center of mass tracking detection mode. These new data are only available when the SMART-TW is used and the TriWise detection mode is selected in the **Detection Settings** panel (or when that option was enabled during the acquisition of the selected trial).

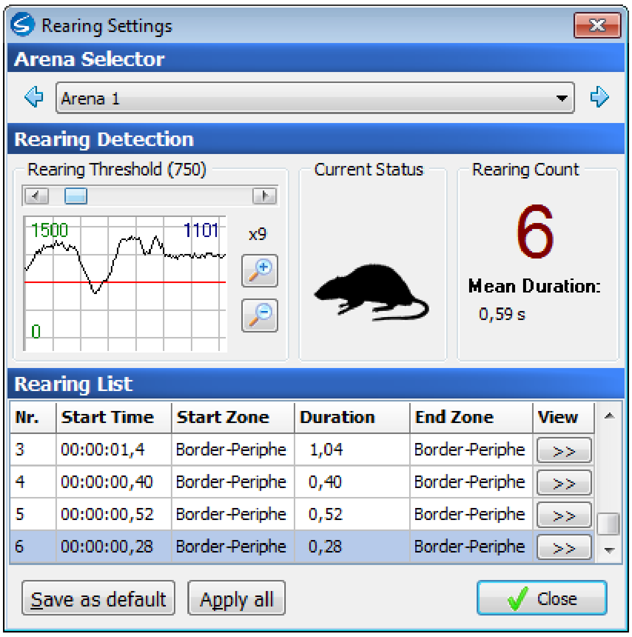
Indeed, the SMART-TW users are provided with additional runtime information and adjustments related to the rearing, rotation and stretching detection.



Rearing

The rearing data represent an estimation of the animal vertical activity. The rearing behavior is considered as an index of animal exploration.

To configure the rearing detection threshold, press the  button available in the right side of the **Rearing** field in the **General data** section of the **Runtime Viewer** panel. The **Rearing Settings** panel is shown:



SMART-MA

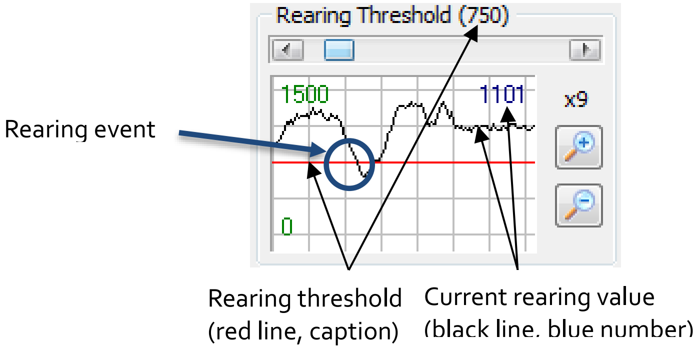
An "Arena selector" control is provided for SMART-MA users within the **Rearing Settings** panel to adjust the rearing threshold for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

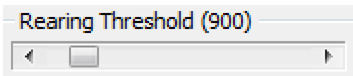
In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

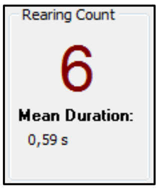
A single rearing threshold must be set. Its value depends mainly on the animal's size in normal conditions and during the rearing events.

During the detection test and during acquisition, the graph shows the current "rearing value" and its history. The "rearing value" represents the inverted height of the subject. The higher the rearing value, the lower the subject. If the rearing value is lower than usual, the subject is higher, and consequently, rearing.



To detect a rearing event, the rearing threshold must be set correctly using the scroll-bar in the **Rearing Threshold** box. It is considered that the subject is rearing when the rearing value is lower than the rearing threshold. To accurately detect rearing events, set the rearing threshold (red line) so that it is above the rearing value (black line) while the subject is rearing, but below the rearing value while the subject is not rearing.





The detected rearing events are also shown in the **Rearing List** table. A counter at the top of the panel shows how many rearing events where detected to the moment and the average of the duration of all rearing.

Rearing List

Nr.	Start Time	Start Zone	Duration	End Zone	View
3	00:00:01,4	Border-Periphe	1,04	Border-Periphe	>>
4	00:00:00,40	Border-Periphe	0,40	Border-Periphe	>>
5	00:00:00,52	Border-Periphe	0,52	Border-Periphe	>>
6	00:00:00,28	Border-Periphe	0,28	Border-Periphe	>>

The **Rearing List** table displays the following information:

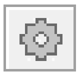
- **Nr**: the sequence number of the rearing event starting at 1.
- **Start Time**: the relative time in which the rearing event was detected following the criteria described before (rearing value below the rearing threshold).
- **Start Zone**: the name of the zone in which the subject was considered to be when the rearing event started.
- **Duration**: the total duration (in sec) of the rearing event. A rearing event is finished when the rearing value is again higher than the rearing threshold.

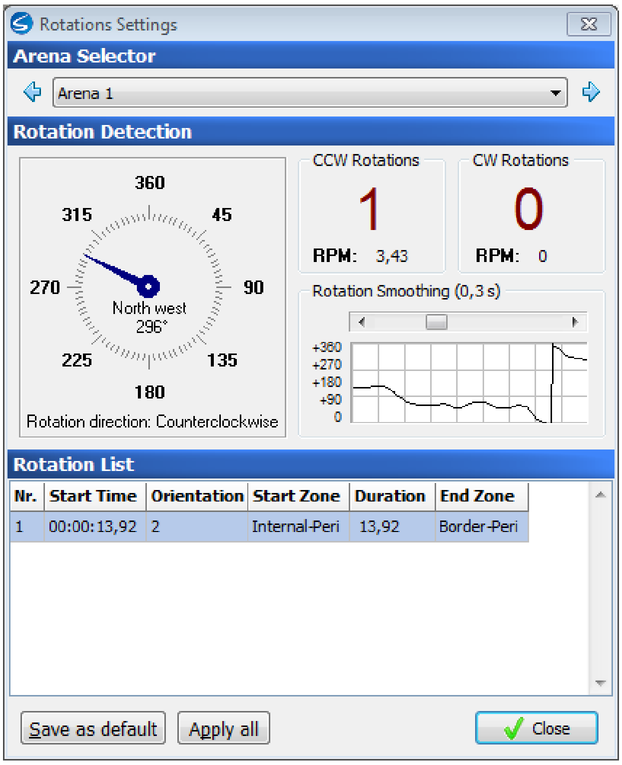
- **End Zone**: the name of the zone in which the subject was considered to be when the rearing event finished.

If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided also within the **Rearing List** table to "replay" each rearing event in the **Player** panel. Press the **Stop** button on the **Digital Video Control** panel to stop the video again.

Rotation

SMART-TW users are provided with specific tools to automatically detect animal rotation events. The total number of CW (clockwise) and CCW (counter-clockwise) rotations are shown in the Rotation section.

To configure the rotation detection threshold, press the  button available in the right side of the **Rotations** field in the **General data** section of the **Runtime Viewer** panel. The **Rearing Settings** panel is shown:



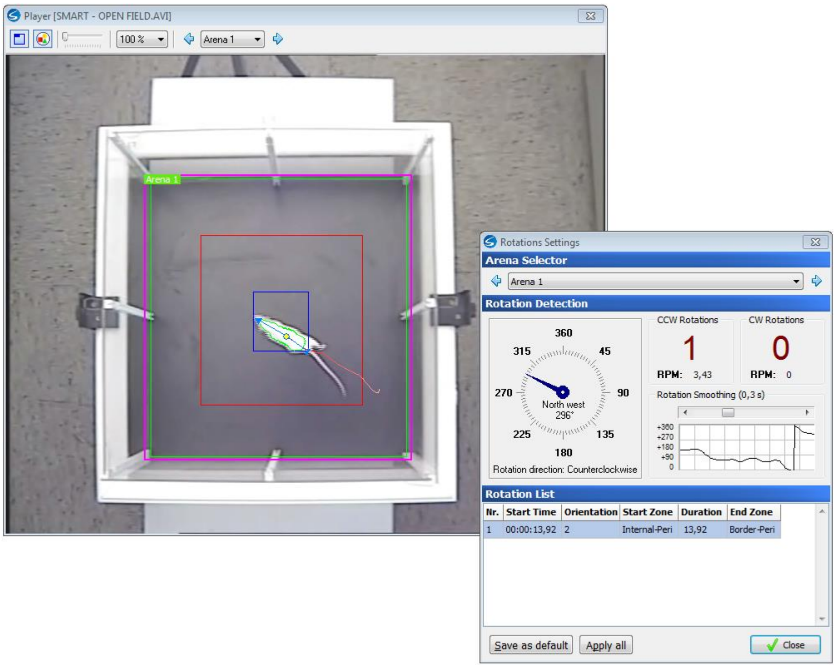
SMART-MA

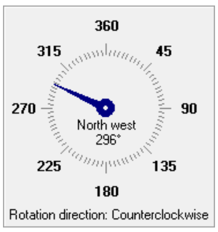
An "Arena selector" control is provided for SMART-MA users within the **Rotations Settings** panel to adjust the rotation detection settings for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

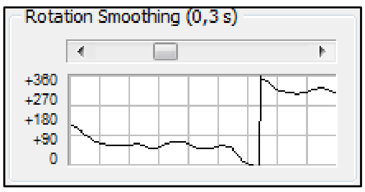
In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

A single rotation smoothing value must be set. This value mainly depends on the subject activity (quick small changes in orientation) and the quality of the image.



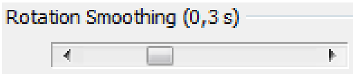


During the detection test and acquisition, the compass represents the current orientation in degrees of the subject. It is possible to read the precise value of the current orientation and its cardinal orientation inside the compass.

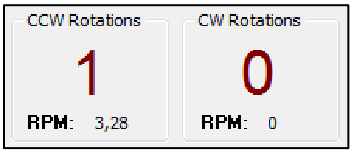


The graph shows the history of the orientation in degrees. It is possible to configure the smoothing of the orientation by moving the scroll-bar in the

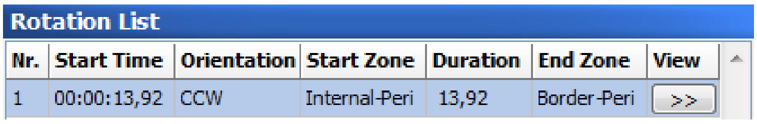
Rotation Smoothing box. The smoothing is configured in seconds. The current orientation is calculated as the current orientation averaged with the samples of the last seconds configured by the scroll-bar in the **Rotation smoothing** box.



A rotation is detected when the subject's orientation passes through all cardinal points in strict order. If the order is "broken", no rotation is considered.



The rotations detected are also shown in the **Rotation List** table. Two counters at the top of the panel show the amount of counter clockwise and clockwise rotations and their RPM (rotations per minute).



The **Rotations List** table displays the following information:

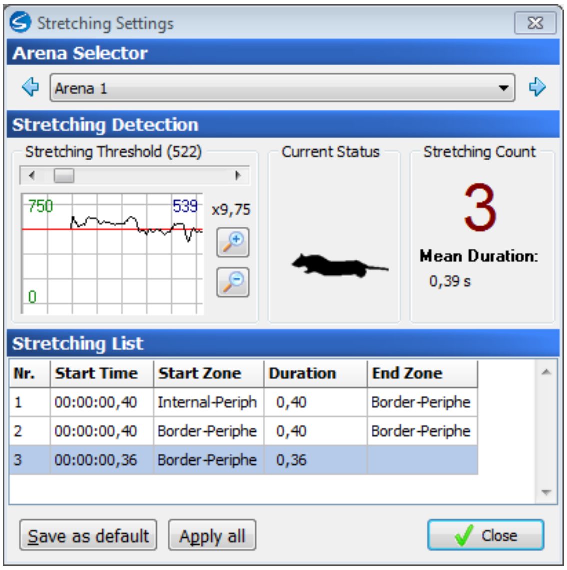
- **Nr**: the sequence number of the rotation event starting at 1.
- **Start Time**: the relative time in which the rotation started following the criteria described before.
- **Orientation**: turning direction in which the rotation was done (CW = Clockwise, CCW = Counter clockwise).
- **Start Zone**: the name of the zone in which the subject was considered to be when the rotation started.
- **Duration**: the total duration (in sec) of the rotation.
- **End Zone**: the name of the zone in which the subject was considered to be when the rotation finished.

If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided also within the **Rotation List** table to "replay" each rotation in the **Player** panel. Press the **Stop** button on the **Digital Video Control** panel to stop the video again.

Stretching

SMART-TW users are provided with specific tools to automatically detect animal's stretching events. The total number of streching behavior is shown in the Stretching section.

To configure the stretching detection threshold, press the button available in the right side of the **Stretching** field in the **General data** section of the **Runtime Viewer** panel. The **Stretching Settings** panel is shown:



SMART-MA

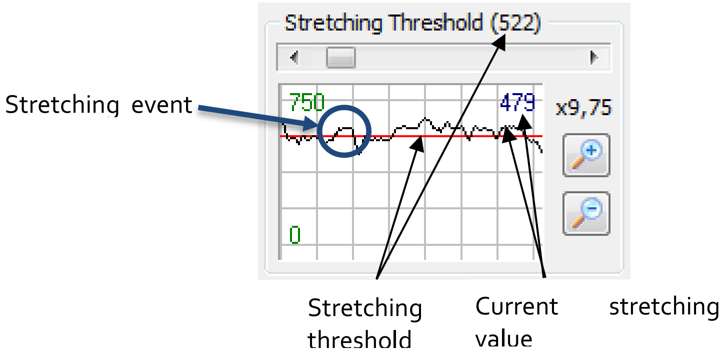
An "Arena selector" control is provided for SMART-MA users within the **Stretching Settings** panel to adjust the stretching detection threshold for each arena independently.

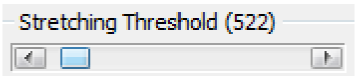
Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

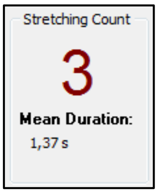
A single stretching threshold must be set. Its value depends mainly on the animal's size in normal conditions and during the stretching events.

During the detection test and during acquisition, the graph shows the current "stretching value" and its history. The "stretching value" represents the total length of the subject's body (from head to tail). The higher the stretching value, the longer the subject's body. If the stretching value is higher than usual, the subject is longer, and consequently, stretching.





To detect a stretching event, the stretching threshold must be set correctly using the scroll-bar in the **Stretching Threshold** box. It is considered that the subject is stretching when the stretching value is higher than the stretching threshold. To correctly detect stretching events, set the stretching threshold (red line) so that it is below the stretching value (black line) while the subject is stretching, but above the stretching value while the subject is not stretching.



The detected stretching events are also shown in the **Stretching List** table. A counter at the top of the panel shows how many stretching events where detected to the moment and the average of the duration of all stretching.

Stretching List

Nr.	Start Time	Start Zone	Duration	End Zone	View
1	00:00:00,40	Internal-Periph	0,40	Border-Periphe	>>
2	00:00:00,40	Border-Periphe	0,40	Border-Periphe	>>
3	00:00:03,32	Border-Periphe	3,32	Border-Periphe	>>

The **Stretching List** table displays the following information:

- **Nr**: the sequence number of the stretching event starting at 1.
- **Start Time**: the relative time in which the stretching event was detected following the criteria described before (stretching value below the stretching threshold).
- **Start Zone**: the name of the zone in which the subject was considered to be when the stretching event started.

- **Duration**: the total duration (in sec) of the stretching event. A stretching event is finished when the stretching value is again higher than the stretching threshold.

- **End Zone**: the name of the zone in which the subject was considered to be when the stretching event finished.

If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided also within the **Stretching List** table to "replay" each stretching event in the **Player** panel. Press the **Stop** button on the **Digital Video Control** panel to stop the video again.

13.3.2. Trial data

Trial data are global data provided for a trial independently of the number of subjects assigned to the trial.

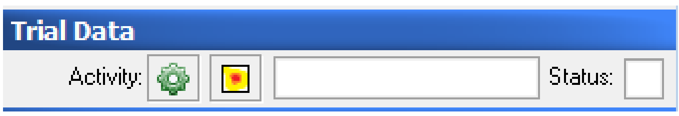
A trial data section is only shown in two cases:

- when working with SMART-GA and Activity Detection mode is selected in the **Detection setting** panel.
- When working with the SMART-SI module and one of the Tracking detection mode is selected with more than 1 subject in the **Detection setting** panel.

13.3.2.1. Activity detection mode (SMART –GA)

When using the Activity detection mode provided by the SMART-GA module, new Trial data are provided. These new data are only available when the SMART-GA is used and the Activity detection mode is selected in the **Detection Settings** panel (or when that option was enabled during the acquisition of the selected trial).

Indeed, the SMART-GA users are provided with additional runtime information and adjustments related to animal activity pattern.



SMART-GA users are provided with detailed information about the general activity of the subjects assessed during the data acquisition process.

Global activity

The global activity of the subject or group of subjects registered in the trial is shown in the Activity box. The data are given in the units specified during the calibration, cm^2/s or $inch^2/s$.

Movement pattern

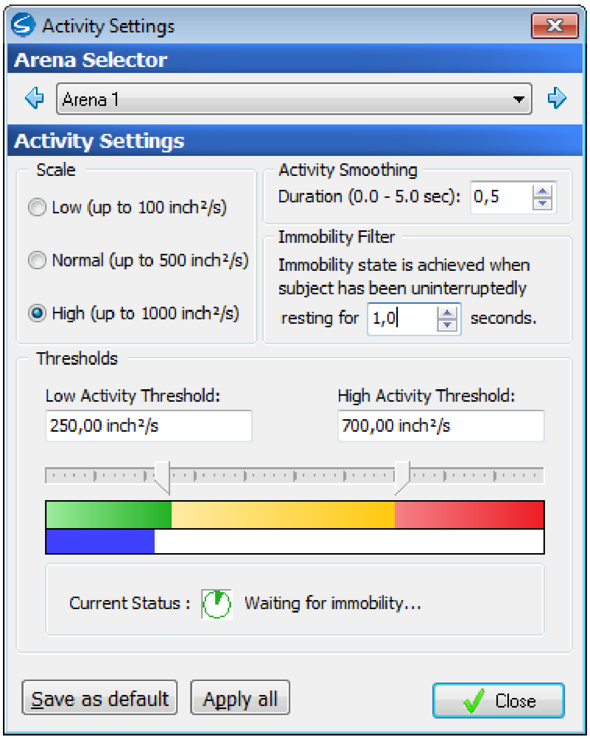
The activity status field represents the level of the subject immobility/activity depending on the activity thresholds adjusted in the **Activity Settings** panel:

Represents immobility

Represents a low activity level.

Represents a high activity.

The button displays the **Speed Settings** panel for settings the Activity thresholds.



SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Activity Settings** panel to adjust the activity thresholds for each arena independently.

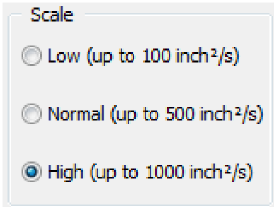
Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

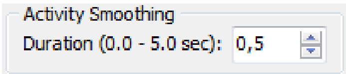
Three parameters are configurable. The value of each one depends on variables such as the animal's size and motor capacities of the strain used and the specific conditions of your experiment:

Activity scale

Allows selecting the maximum activity level (in the square units used during the calibration process) the animal can reach:



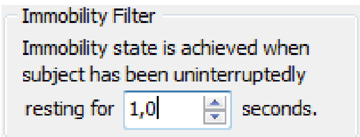
Activity Smoothing



A period of time (in sec) in which the activity level is averaged before determining the punctual activity. This option minimizes the impact that the artifacts in the image can produce on the activity calculations.

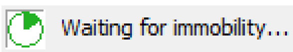
A default value of 0.5 sec is configured. This value is suitable in most cases but you can adjust it between zero sec (no smoothing applied; the current activity level is exactly the punctual activity) and 5 sec (the punctual activity during the last 5 sec is averaged to calculate the current activity level).

Activity Thresholds

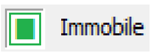


- Immobility Filter:

  A period of time (in sec) the animal must remain under a "Low Activity" status to be considered effectively as an "immobility" episode.



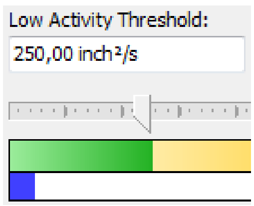
  Each time the animal reaches a "Low Activity" status, an immobility detection period is started. It is reflected with a **Waiting for immobility** sign in the **Current Status** field of the **Activity Settings** panel.



  If the animal remains under the "Low Activity" status during a time equal or longer than the configured in the **Activity Smoothing** field, then the sign changes to **Immobile**.

- Low activity threshold:

  Threshold under which the "immobility" state is evaluated.



- High activity threshold:

  Threshold above which the animal is deemed to be "highly active".

  The thresholds can be adjusted by dragging the markers along the horizontal rule.

  A fine adjustment can be achieved by clicking the rule and using then the following combination key strokes:

  - [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "Low Activity Threshold".
  - [CTRL] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "High Activity Threshold".
  - [SHIFT] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease both thresholds at the same time.

  SMART allows changing the values of the thresholds during the data acquisition process also to allow the greatest flexibility to the user.

  The values chosen during the detection test and during the acquisition process can be changed afterward during the analysis process for obtaining a new set of data.

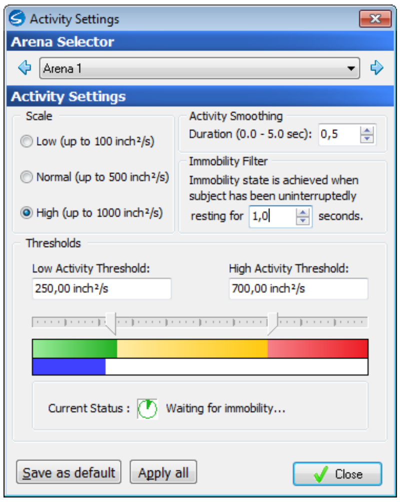
The entire trial to which the values of the thresholds have been changed during the data acquisition process should be reanalyzed again in **Analysis** mode with your final choice of thresholds.

In order to generate a statistically relevant data set, it is recommended to use the same threshold for all the animals of the same experiment to compare the data between the different experimental groups.

The following are some recommendations for setting the activity thresholds properly:

- Before starting the data acquisition, perform a detection test with a pilot animal and have a look on the **Activity Settings** panel during animal immobility and activity, depending on your own criteria.

  In the present example, the criterion configured was so that the subject remains immobile when there was no more than 250 inch²/sec of activity (that is, an accumulated area smaller than 250 inch² changes between consecutive images for each second) during at least 1 sec consecutively.

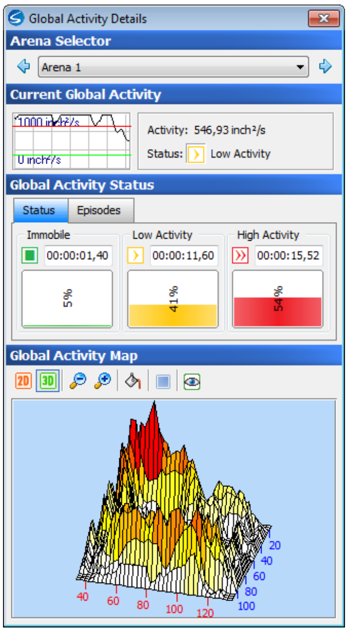


  If the experiment is videotaped, the video can be analyzed again using a different threshold.

- In the **Analysis** module, you will be allowed to adjust the time threshold for excluding any immobility episodes which duration is lower to the defined threshold. This time threshold allows eliminating any non-specific pause of activity which cannot be considered and a true immobility episode.

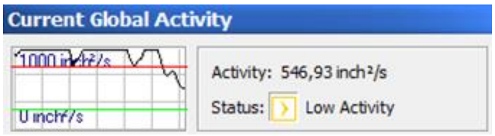
Global activity details

The **Global Activity Details** panel can be accessed through the button associated to the **Activity** field in the **Runtime Viewer** panel. This panel shows additional information about the subject global activity such as the time the subject has been in the different activity statuses, the list of activity episodes and the total accumulated activity map.



Current global activity

This section shows the current global activity and the current global activity status. The scope shows the global activity throughout time and the current activity threshold values.



The status field represents the level of the subject general activity depending on the activity thresholds adjusted in the **Activity Settings** panel:

Represents an immobility state.

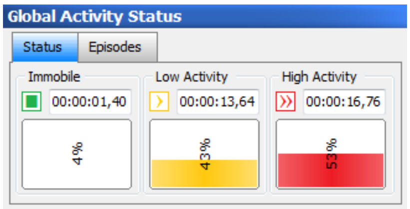
Represents a low activity level.

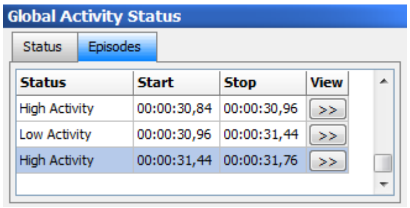
Represents a high activity level.

The global activity information gathered during the data acquisition is stored into the experiment file with a precision of 1 minute so that it may be re-analyzed later.

Global activity status

This section shows the time and its percentage that the subject has been in the different activity states. A table shows the history of all the different activity episodes throughout the trial.





If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided to "replay" each change on the activity status in the **Player** panel.

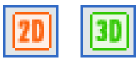
Global activity map

The **Global Activity Map** tool is a basic visual tool showing an illustrative view of the zones of maximal activity achieved along the acquisition process. This tool does not generate any numeric data that could be used for calculation or statistic. It is strictly for illustration purposes only.

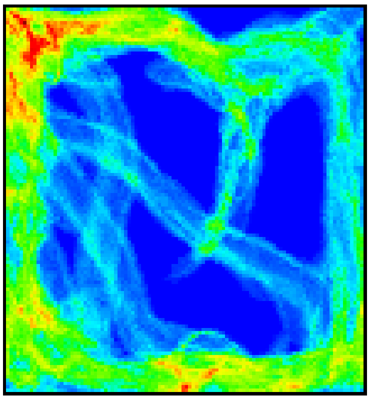
The activity map is based on the detection of changes of pixels occurring between two consecutive frames into the entire captured image (the distribution of activity does no takes into account the zones drawn by the user).

The red color illustrates the zones that underwent the greatest pixel changes and the yellow color, the zones that underwent the fewest pixel changes. White color indicates zones where no changes have been detected during the experiment.

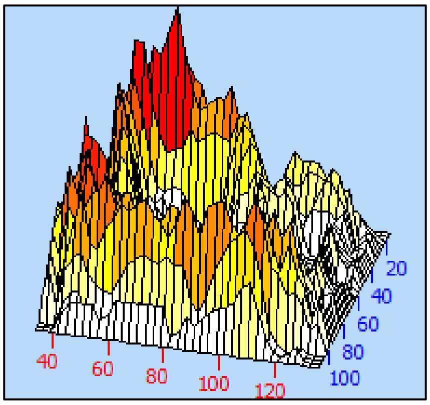
When the **Global Activity Map** is opened during the data acquisition, the image is automatically updated every second to represent the map of total accumulated activity.



The **Global Activity Map** may be visualized in 2D or 3D by selecting the respective buttons.



2D activity map

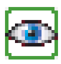


3D activity map (the same as 2D)

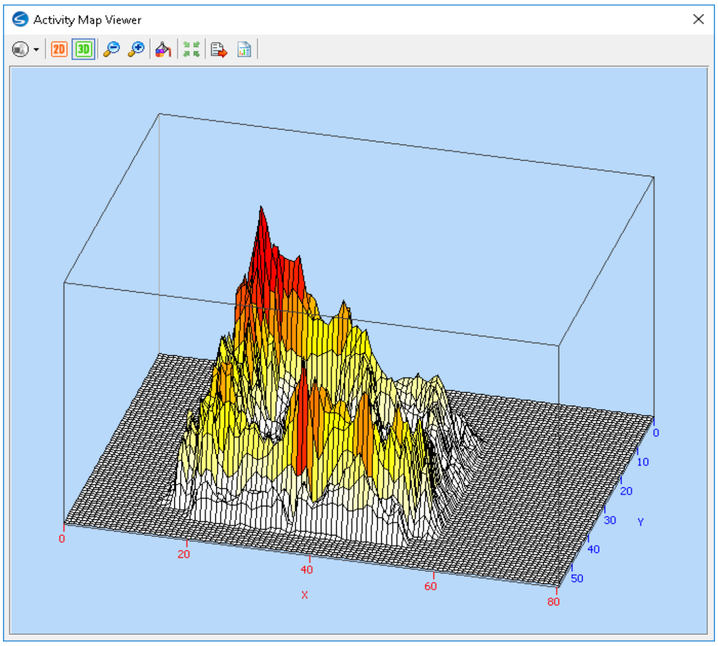
The background color may be altered using the **Select background color** button.

If viewing the map in 3D, it is possible to rotate the map by dragging the map with mouse. In that case it is also possible to zoom in and out the 3D view of the activity map by using the **Zoom in** and **Zoom out** buttons.

The 3D view may be restored by using the **Reset 3D map** button.



An **Activity Map Viewer** tool can be launched to analyze the activity map in detail and export the image. To open this tool, use the **Export activity map image** button.



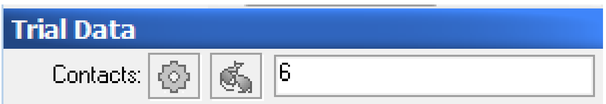
The activity map may be now exported as a portable network graphics (.PNG file) using the button.

The raw data used to generate the activity map may be now exported to a text file (.TXT) using the button.

13.3.2.2.interaction module (SMART –SI)

When working with the SMART-SI module and one of the Tracking detection modes is selected (center of mass, TriWise, color modes) with more than 1 subject in the **Detection setting** panel, new Trial data are provided in the runtime panel.

Indeed, the SMART-SI users are provided with additional runtime information and adjustments related to animal social interaction behaviour.



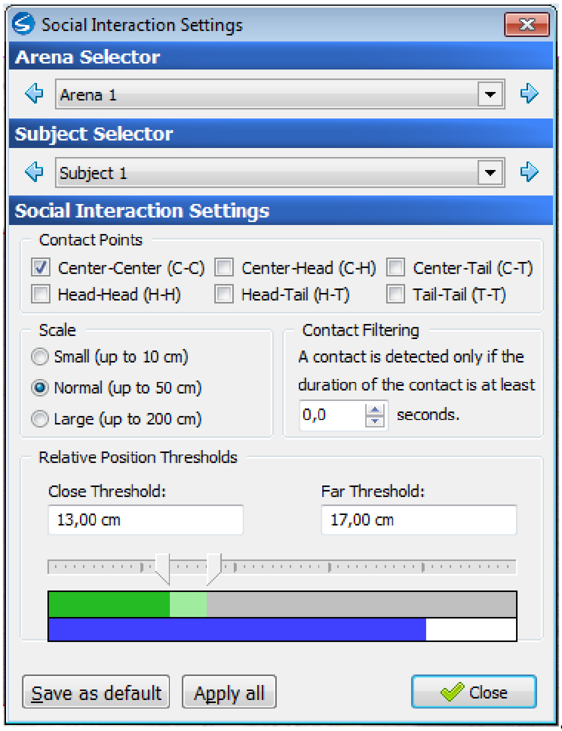
Contact number

The total number of contacts detected between subjects in the trial is shown into the **Contacts** box. The detection of the contacts between subjects depends on the user definition of the Relative Position Thresholds available from the Social interaction settings panel.

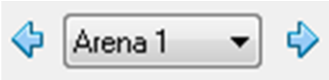
Social interaction settings

The SMART-SI module provides data about the relative position between the animals assigned in the same trial for registering not only contacts but also close position/Far positions. The detection of these social interaction events is related with the evolution of the distance between the different subjects under study.

The button displays the **Social Interaction settings** panel for settings the animal relative position thresholds.



SMART-MA



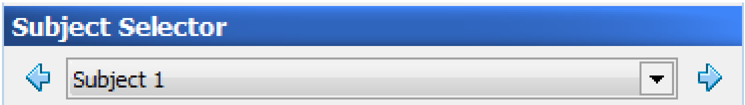
An "Arena selector" control is provided for SMART-MA users within the **Social Interaction Settings** panel to adjust the settings for each arena independently.

Select the arena to configure (with the selector or clicking directly at the **Player** panel) and adjust the parameters freely.

In order to apply the new settings to all the arenas simultaneously, press the button **Apply all**.

Subject selector

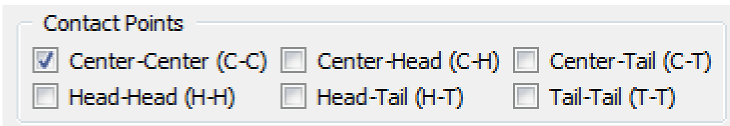
The Subject selector is only displayed when more than 2 subjects are assigned to the current trial.



The selected subject in the panel will define the subject to which the current distance with the other subjects of the trial will be shown in the Relative Position Threshold section of the Social Interaction settings panel.

Contact Points (SMART-TW)

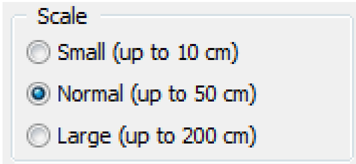
The Contact Points selector is only available when using the SMART-TW module and when the TriWise Tracking detection mode is selected in the Detection settings panel.



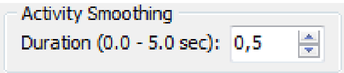
Select the kind of contact to be considered in the data shown in the runtime panel: Contact number, Relative position list table. This selection can be changed during the analysis process for generating a new set of data.

Social interaction scale

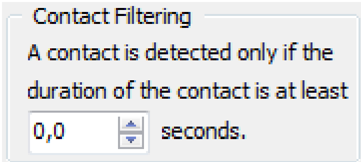
The social interaction scale allows selecting the maximum distance level between subjects (in units selected during the calibration process).



Contact Filtering

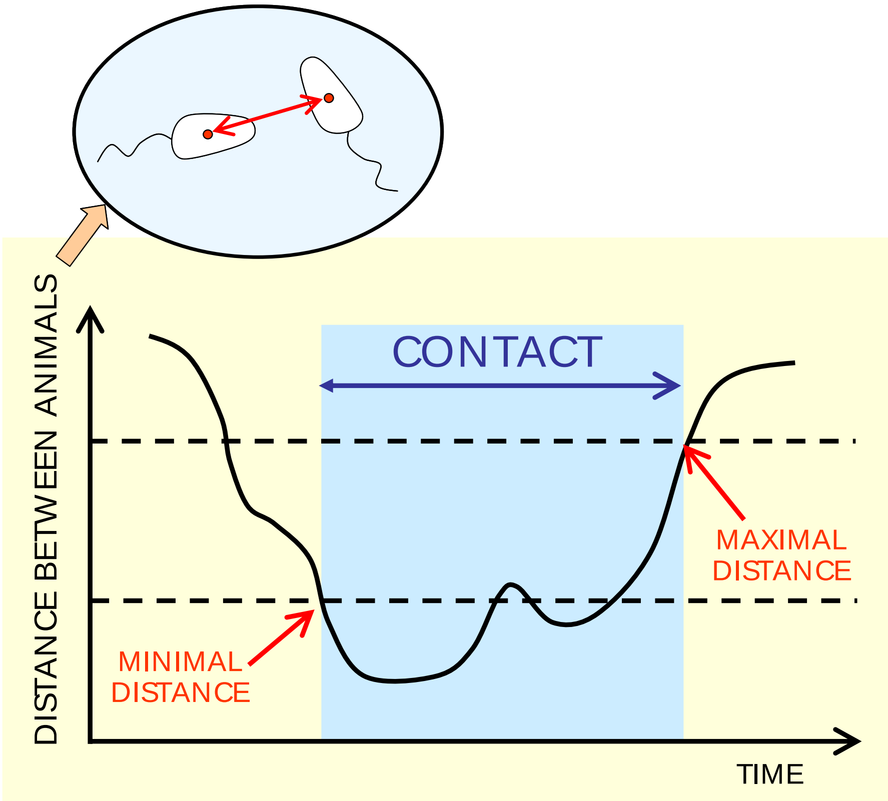


The contact filtering option allows the system rejecting any contact which duration is lower that a user-defined duration. This parameter can be changed during the analysis process for generating a new set of data.



Relative position Thresholds

The thresholds are used for defining the relative position between the subjects assigned to the same trial.



Basically, a contact is a function of the distance between 2 subjects implemented as a "hysteresis" condition, thanks to two thresholds: a minimal distance in order to consider the beginning of a contact, and a maximal distance in order to consider this contact is broken.

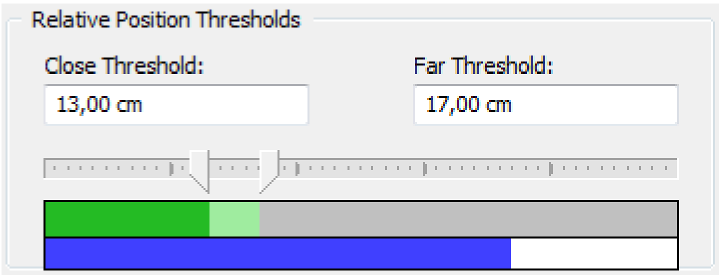
When the distance between the 2 animals is higher than the **Far threshold**, the relative position between the animal is considered as **FAR**.

When the distance between the 2 animals is decreasing from the FAR status and reach values lower than the **Far threshold** and higher than the **Close threshold**, the relative position between the animal is considered as **CLOSE**.

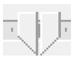
When the distance between the 2 animals continue to decrease from the CLOSE status and reach values lower than the **Close threshold**, the relative position between the animal is considered as **CONTACTING**.

The contact ends when the distance between the 2 animals increase until reaching values higher than the **Far threshold**. In that case, the relative position between the animal is considered as **FAR** again.

The Close and Far thresholds can be adjusted in the Social Interaction panel.



The blue bar shows the current distance between the subject selected into the Subject Selector and the closer of the other subjects assigned to the same trial.



The thresholds can be adjusted by dragging the markers along the horizontal rule.

A fine adjustment can be achieved by clicking the rule and using then the following combination key strokes:

- [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "Close Threshold".
- [CTRL] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease the "Far Threshold".
- [SHIFT] + [LEFT ARROW] / [RIGHT ARROW]: To increase / decrease both thresholds at the same time.

SMART allows changing the values of the thresholds during the data acquisition process also to allow the greatest flexibility to the user.

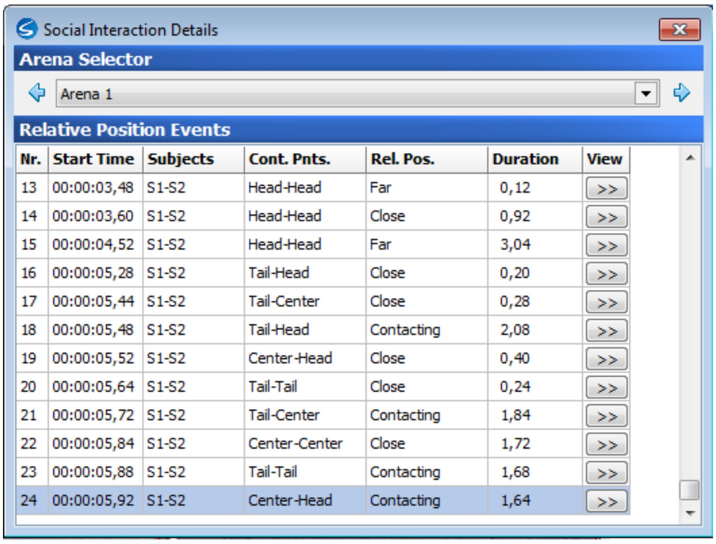
The values chosen during the detection test and during the acquisition process can be changed afterward during the analysis process for obtaining a new set of data.

The entire trial to which the values of the thresholds have been changed during the data acquisition process should be reanalyzed again in **Analysis** mode with your final choice of thresholds.

In order to generate a statistically relevant data set, it is recommended to use the same threshold for all the animals of the same experiment to compare the data between the different experimental groups.

Social Interaction Details

The Social Interaction Details table shows the details of the Social Interaction events registered during the data acquisition process.



Nr.	Start Time	Subjects	Cont. Pnts.	Rel. Pos.	Duration	View
13	00:00:03,48	S1-S2	Head-Head	Far	0,12	>>
14	00:00:03,60	S1-S2	Head-Head	Close	0,92	>>
15	00:00:04,52	S1-S2	Head-Head	Far	3,04	>>
16	00:00:05,28	S1-S2	Tail-Head	Close	0,20	>>
17	00:00:05,44	S1-S2	Tail-Center	Close	0,28	>>
18	00:00:05,48	S1-S2	Tail-Head	Contacting	2,08	>>
19	00:00:05,52	S1-S2	Center-Head	Close	0,40	>>
20	00:00:05,64	S1-S2	Tail-Tail	Close	0,24	>>
21	00:00:05,72	S1-S2	Tail-Center	Contacting	1,84	>>
22	00:00:05,84	S1-S2	Center-Center	Close	1,72	>>
23	00:00:05,88	S1-S2	Tail-Tail	Contacting	1,68	>>
24	00:00:05,92	S1-S2	Center-Head	Contacting	1,64	>>

The table only show the data of the contact points selected into the Contact Points selector of the Social interaction Settings panel.

If a finished trial is being reviewed (by selecting it on the Scheduler's tree) and a digital video was selected as the image source, a **View** button is provided to "replay" in the **Player** panel the video corresponding to the social interaction event registered in the table.

13.3.3. Protocol specifics data

The **Protocol Specifics** section in the **Runtime Viewer** panel provides detailed information closely related to the experimental module selected.

This information is composed by a set of arithmetical and statistical calculations arranged in numerical fields and tables depending on the needs of the experimental paradigm.

13.3.3.1.Tracking detection mode

The following data are provided when the data acquisition process is done using any of the 3 tracking modes available depending of the SMART extension purchased (centre of gravity, 3-point TriWise and color detection).

- **Distance**: the accumulated distance travelled by the subject measured in the units specified during the calibration of the system.
- **Permanency Time**: the accumulated time (in seconds) the subject has spent into each of the defined zones and associations. The percentage of the total time spent into each zone and association is also shown.

  Permanency times and percentages per zone are shown in the **Time** and **T. %** rows in the table.

Protocol Specifics

Permanency Time

	Border	Center	Periphery	Total
Time	29,04	0,44	36,64	37,08
T. %	78,32	1,19	98,81	100,00

When using the SMART-CS module, the calculations will be provided for each zone or association considered as zone of interest in the Zone and association management tool (see chapter 7.2.5).

When using the SMART experiment targeted modules alone, zones and association used for calculation are predefined and cannot be modified by the user.

13.3.3.2.Activity detection mode (SMART-GA)

The **Protocol Specifics** section provides SMART-GA users generic information about the global activity assessed during the trial execution:

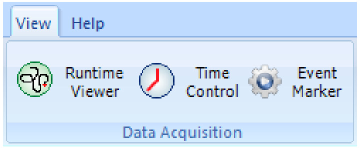
- **Global Activity**: the accumulated activity (measured in the units specified during the calibration) the subject has made into each of the defined zones and associations. The percentage of the total activity made into each zone and association is also shown.

  Accumulated activity and percentages per zone are shown in the **Activity** and **A. %** rows in the table.

Protocol Specifics

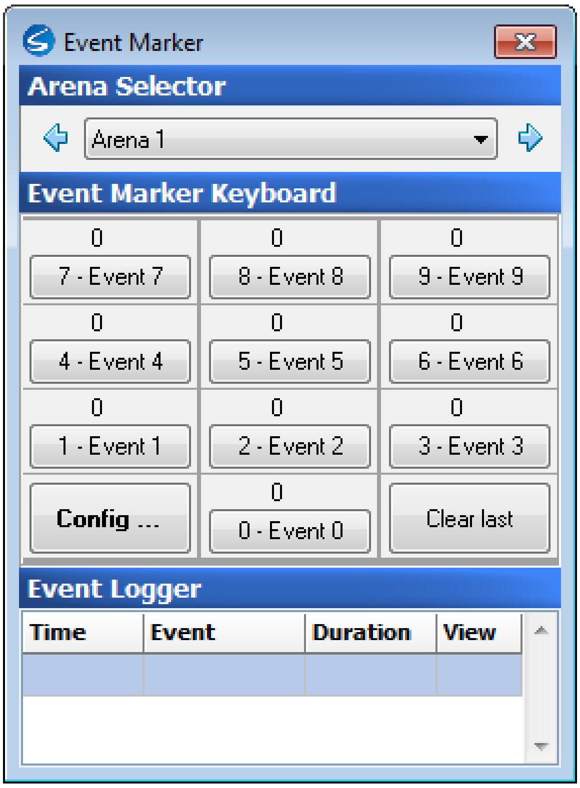
Permanency Time and Global Activity

	Border	Center	Periphery	Total
Time	49,32	1,56	60,68	62,24
T. %	79,24	2,51	97,49	100,00
Activity	7023,46	437,69	9662,41	10100,10
A. %	69,54	4,33	95,67	100,00



13.4. Recording events

SMART provides the **Event Marker** tool to record events of interest which have happened during the executing of a trial.



SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Event Marker** panel. Select the arena (with the selector or clicking directly at the **Player** panel) to review the information related to the recorded events and to record additional events belonging specifically to that arena.

The **Event Marker** panel is arranged in two sections:

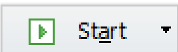
- The **Event Marker Keyboard**: with a button for each kind of event to record and the number of occurrences of each one.
- The **Event Logger** table: shows the list of events currently recorded with the following information:
    - **Time**: the relative time (in hh:mm:ss,c) in which the event of interest started.
    - **Event**: the name of the event of interest recorded, as defined in the **Event Settings** panel.
    - **Duration**: the duration (in sec) of the event of interest recorded.

In order to record events of interest with the help of the **Event Marker** tool:

1. Make the **Event Marker** panel visible.

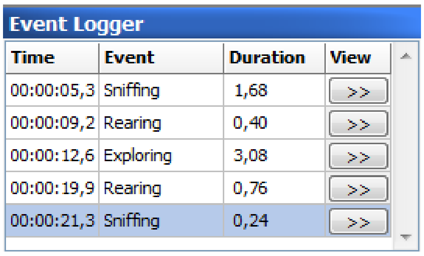
2. Configure the events of interest by mean of the **Event Settings** panel.
3. If multiple arenas are defined, click on the **Player** panel or use the **Arena Selector** tool to select the arena in which the events will be recorded.

4. Make sure that the numeric keypad is enabled ([NUM LOCK] key must be pressed).



5. Configure and start the trial (data acquisition).

6. Review the image and press the numeric keys depending on the kind of event visually identified. Keep the key pressed for the duration of the event to be marked.



Event Logger

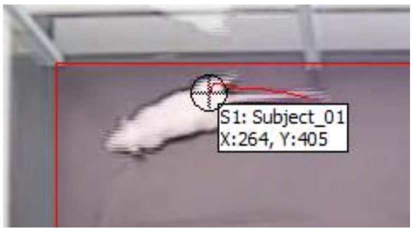
Time	Event	Duration	View
00:00:05,3	Sniffing	1,68	>>
00:00:09,2	Rearing	0,40	>>
00:00:12,6	Exploring	3,08	>>
00:00:19,9	Rearing	0,76	>>
00:00:21,3	Sniffing	0,24	>>

If a finished trial is being reviewed (by selecting it on the **Scheduler**'s tree) and a digital video was selected as the image source, a **View** button is provided to "replay" each event of interest in the **Player** panel.

13.5. Tracking Subject Position in Manual Tracking Mode

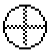
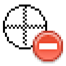
If **Manual Tracking** mode is selected in the **Detection Settings** panel as described in page 86, then the position of the subject is not detected automatically and has to be indicated by the user using the mouse-cursor over the image shown in the player.

To do so, after the experiment has been started as described in page 209, hold the mouse cursor over the position of the subject, press and hold the left mouse button and move the mouse over the subject as it moves to track its position. The subject track is marked with a red line following the cursor position as indicated by the user.



In case a digital video file is used as an image source, then the video will only be played while the left mouse button is pressed, making it possible to pause the acquisition at any moment. In case of a live image source (as a webcam), the tracking will not be paused and data will be interpolated in segments where the position of the subject was not indicated (left mouse button pressed).

Furthermore, the indicated position cannot be outside the area of the arena. The icon of the cursor will show whether the position of the cursor within the player is valid or not:

Valid:  Invalid: 

13.6. Atlantis Platform Monitor and Manual Control

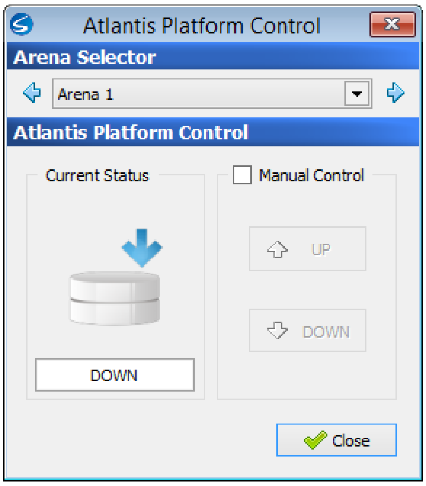
SMART-CS

The Atlantis platform is an automated island for Morris Water Maze Test. SMART-CS module enables SMART to control the Atlantis platform manually or automatically. For information on how to configure the Atlantis platform, please refer to chapter 12.4.

The rest of this chapter only applies to SMART-CS users.

To use the Atlantis platform, it has to be configured first as described in chapter 12.4.

Before starting the data acquisition of a trial, it is important to establish the initial status of the platform. By default, the default status of the Atlantis platform is DOWN. To see and to establish the current status of the platform, open the **Atlantis Platform Control** panel that can be accessed through the **Atlantis Control** button within the **View** bar menu option.

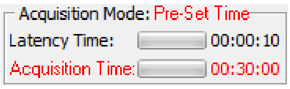


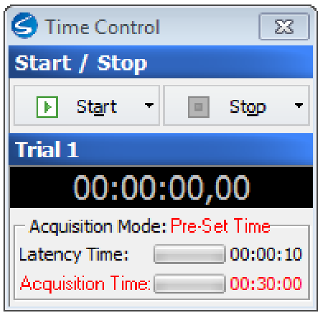
The manual control buttons of the Atlantis platform are disabled by default to avoid activation by mistake. To enable the manual control buttons first select the manual control check-box.

During the execution of a trial, the status of the Atlantis platform will be automatically changed once as configured (see page 163). It is also possible to manually change the status of the Atlantis platform during the execution of a trial.

13.7. Starting and Stopping Trials

When the **Acquisition** mode is selected, the **Time Control** panel is automatically shown. This panel includes:





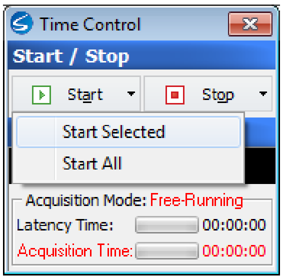
- **Start** and **Stop** buttons to control the next trial.
- The next trial name (defined in the **Schedule** panel)
- The timing adjustments (defined in the **Time Settings** panel) and
- The trial chronometer.

Once a trial is finished in a particular arena, be it because the user presses the **Stop** button (or makes use of the Teleswitch device to stop it) or because the stop condition is fulfilled the acquired data is automatically saved.

In that moment, the trial chronometer is stopped and the **Runtime Viewer** panel is no longer refreshing the information so the last information captured is shown.

If a digital video is used as an image source, it is automatically stopped also.

Finally, the next trial in the **Trial schedule** is automatically selected to be executed.



SMART-MA

SMART-MA users are provided with specific controls to start and stop arenas both individually and simultaneously.

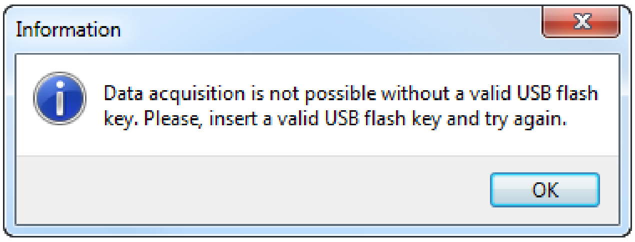
In order to start or stop multiple arenas simultaneously, select first the arenas to start or stop in the **Player** using [CTRL] and/or [SHIFT] and then press the **Start** or **Stop** buttons. This is possible even when a digital video is used as the image source.

On the other hand, the **Start** and **Stop** buttons provide a drop down menu with the **Start all** / **Stop all** option to start or stop all arenas simultaneously without having to select them manually.

In any case, running arenas are shown with a green border while stopped arenas are shown with the classic pink border.

The **Time Control** panel always shows the information from the last selected arena.

Please remember that the data acquisition process can only be started if a valid protection key is plugged in or if the trial period has not expired yet. In other case, the following warning message is shown:



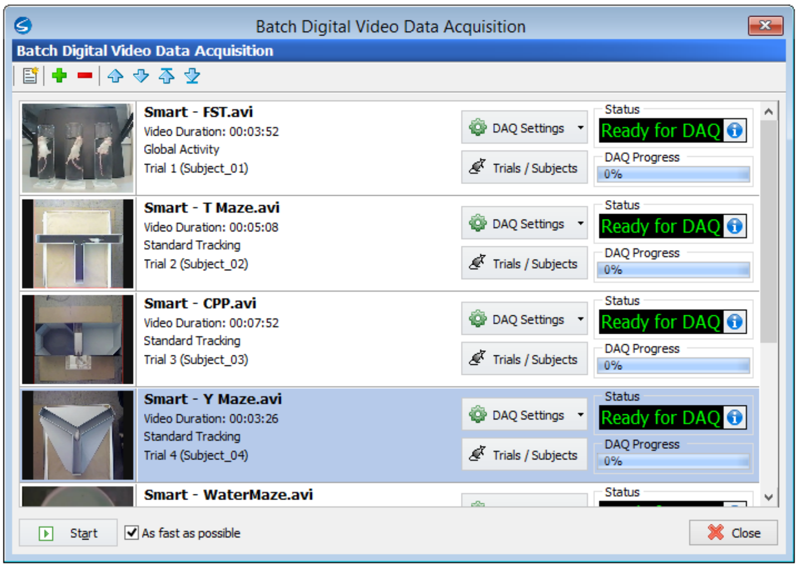
The data acquisition process cannot be started if the **Zones Editor**, **Time Settings** or **Atlantis Settings** are active. Close those panels before starting any trial.

SMART will not enable the data acquisition process unless an animal is detected. If no animal is in the arena, SMART will neither capture data nor count time. The software will keep monitoring the scenario waiting for the animal to be detected. Once SMART detects an animal, it enables data acquisition.

When the **SMART-SI** module is used without SMART-CS module, the acquisition of data for a single-subject tracking is not allowed. The data acquisition will begins only when at least 2 subjects or more are detected into the experimental area. In any case, the acquisition will not start until the system is able to detect individually in the first frame a number of animals similar or higher than the number of animals set in the Detection settings panel. This means that no animal has to be contacting another one for enabling the starting of the data acquisition process.

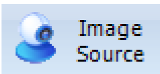
13.8. Batch Data Acquisition

To increase productivity while processing recorded digital video files, the batch data acquisition utility provides the possibility to define a list of video files that will be processed automatically by SMART in the specified sequence.

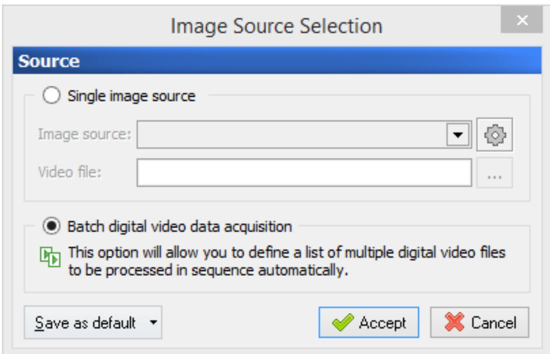


Multiple files can be added at once and individual data acquisition settings can be established for every video individually.

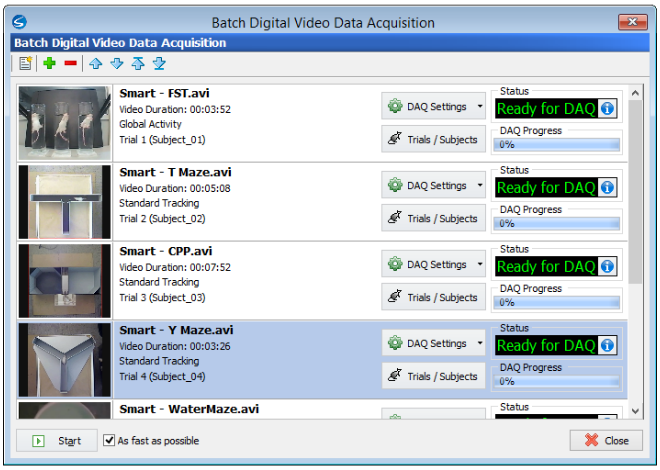
13.8.1. Activating the Batch Data Acquisition Utility



To access the batch data acquisition utility, press the **Image Source** button in the **Experimentation Assistant** bar. The Image Source Selection panel will be shown.



Select the option "**Batch digital video data acquisition**" and press **Accept** to open the batch data acquisition utility.

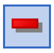


13.8.2. Editing the List of Videos to Be Processed

The batch data acquisition utility offers the following functionalities to add and edit the list of video files to be processed:

 Deletes all the videos currently in the list to start a new batch.

 Shows a dialog to select one or multiple video files to be added to the list of videos to be processed. By default, the settings applied to each video are the one currently being used in the experiment. These can be edited afterwards.

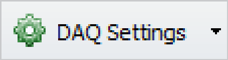
 Deletes the selected videos in the list.

 Moves the selected videos along the list to establish the order in which the videos will be processed.

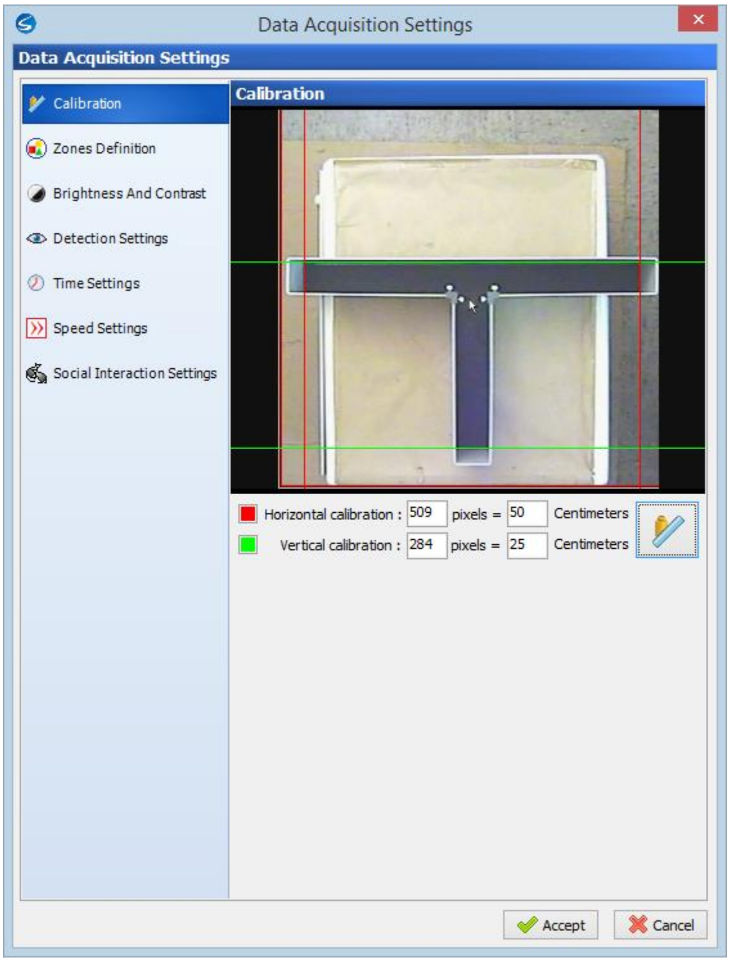
For every video in the list, an entry will be shown containing the following information about the video:

- Thumbnail image
- File name
- Duration
- Data type to be acquired
- Trials and subjects assigned
- Currents status
- Current progress

13.8.3. Configuring a Video for Data Acquisition



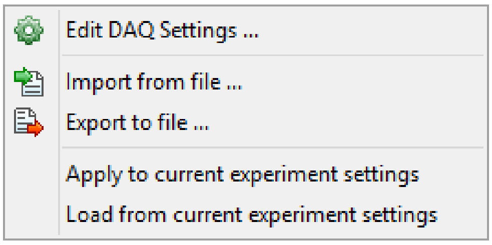
It is possible to specify specific data acquisition settings for every video in the list. To edit the settings of a video, press the **DAQ Settings** button which will show the **Data Acquisition Settings** panel to edit the DAQ settings of each video:



The menu on the left will show the available sections according to the experimental modules and extensions available in the system and according to the active detection modes established in the detection settings. Please refer to the corresponding chapters for more information about how to edit a specific section:

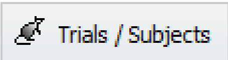
- Calibration : Chapter 6.
- Zones Definition : Chapter 7.
- Brightness and Contrast : Chapter 8.1.
- Detection Settings : Chapter 8.
- Time Settings : Chapter 9.
- Speed Settings : Chapter 0.
- TriWise Settings : Chapter 13.3.1.2.
- Activity Settings : Chapter 0.
- Social Interaction Settings : Chapter 0.

The **DAQ Settings** button contains a drop-down menu which provides access to further utilities to import and export the data acquisition settings:



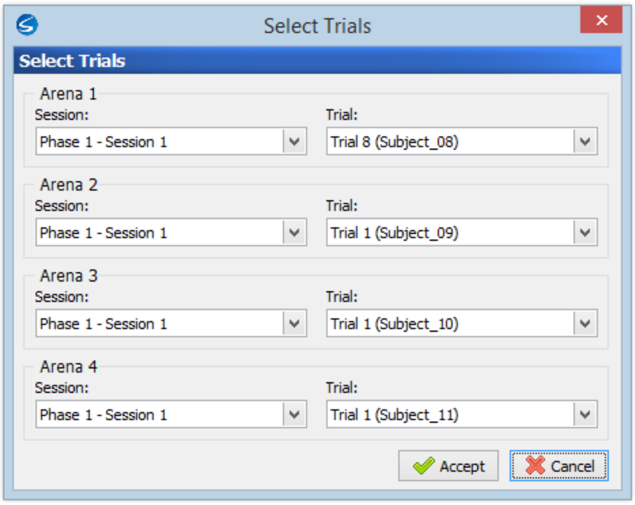
- **Edit DAQ Settings**: Shows the **Data Acquisition Settings** panel described before to edit the DAQ Settings of the corresponding video.
- **Import from file**: Shows a dialog to select a DAQ Settings file to be imported for the corresponding video.
- **Export to file**: Exports the DAQ Settings of the corresponding video to an external file.
- **Apply to current experiment settings**: Applies the DAQ Settings of the corresponding video to the current settings of the experiment. This closes the batch data acquisition utility and opens the image source of the corresponding video.
- **Load from current experiment settings**: Applies the current settings of the experiment to the DAQ Settings of the corresponding video.

13.8.4. Assigning Trials to Videos

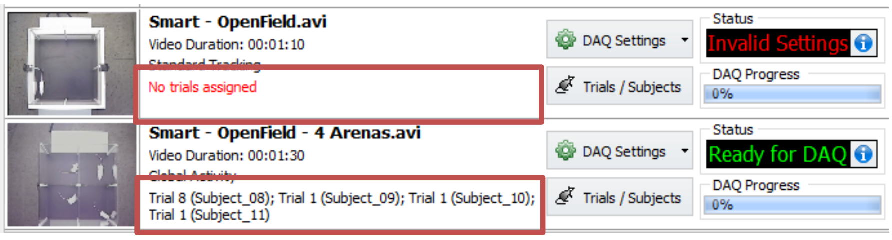


For every video, it is necessary to assign the trials where the data of the corresponding video will be stored. In case various arenas are defined for one video, then one trial for each arena has to be assigned. Before assigning the trials, make sure your scheduler is complete. More information about how to plan the experiment using the scheduler can be found in chapter 11.

To assign the trials of a video, press the button **Trials / Subjects**. The following dialog will be shown.



To assign a trial, select first the session, and then select the trial. The trials assigned to a video are also shown in each entry in the video list:

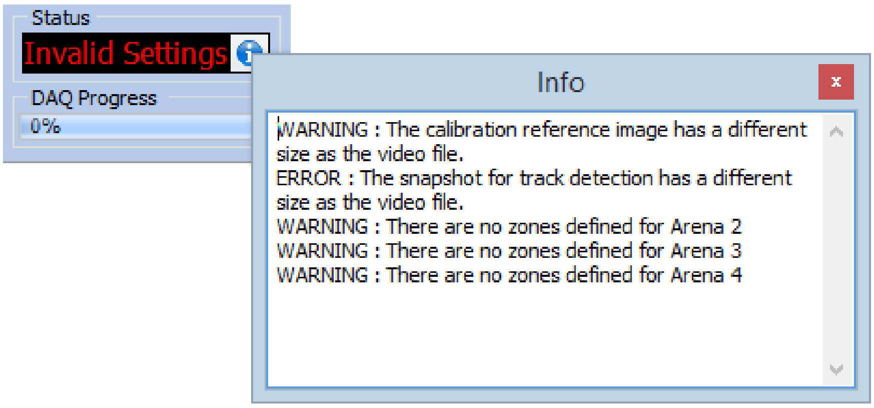


13.8.5. Status of the Video

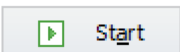
The status of the video is continuously evaluated. The following states are possible:

- **Invalid Settings:** Indicates that the currently established configuration (DAQ Settings and assigned trials) are invalid.
- **Ready for DAQ:** Indicates that the current configuration (DAQ Settings and assigned trials) is ok and that the video is ready for data acquisition.
- **HH:MM:SS,oo:** During the data acquisition of a video, the current time stamp is shown. If the video has been assigned multiple arenas, then it will show the time of the currently selected arena. More information about selecting an arena in the player can be found in chapter 5.1
- **Finished:** Once the video has been processed, this status is shown indicating that the data acquisition process has been successful.
- **DAQ Failed:** Indicated that the data acquisition process has failed.

More information about the current status can be displayed by pressing the  button besides the status name:



13.8.6. Starting the Batch Data Acquisition



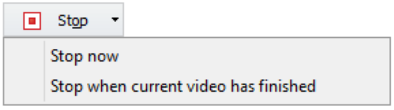
If at least one video in the list is ready for data acquisition, the **Start** button will be enabled. To start the batch data acquisition process, press the **Start** button.

The videos will be processed in sequence from top to bottom. Only the videos with the status **Ready for DAQ** will be processed. In case the status of a video is **DAQ Failed** when starting the batch data acquisition process, then its status is reevaluated and in case all settings are valid for data acquisition, its status will be updated to **Ready for DAQ** and processed as well.

During the batch data acquisition process, if a video could not be processed, the data acquisition will not be cancelled, and it will continue with the next video.

To process the videos as fast as the computers resources allow, select the checkbox **As fast as possible** before starting the batch data acquisition process.

The option **As fast as possible** may not increase the processing speed if there is not enough computational power available. Important factors that determine the speed in which each video is processed is CPU speed, frame size and frame rate.



After all videos have been processed, the batch data acquisition process will stop automatically. To stop the data acquisition at any given moment, press the button **Stop**, which will stop the data acquisition immediately. To stop the data acquisition only after finishing the current video, use the drop-down menu of the **Stop** button and select the option **Stop when current video has finished**.

During the batch data acquisition, the following features are not available:

- Manual Tracking
- Teleswitch
- Atlantis Control
- Manual Event Marker

13.9. Simultaneous recording and tracking

When using a live image source, the **internal built-in RECORD-IT tool** (see chapter 5.1 and 5.3) can be used to record the video of your experiment simultaneously to the tracking process. Here the list of the recommended steps:

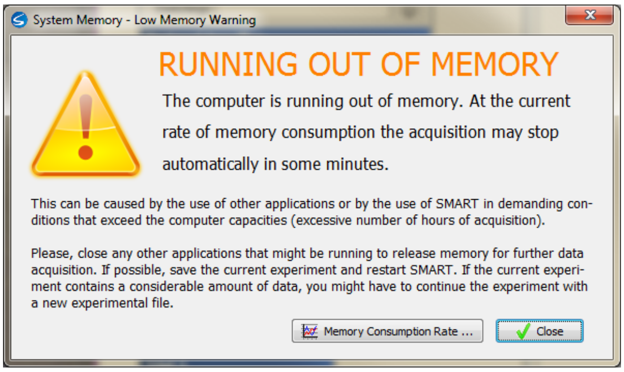
1. Prepare SMART for data acquisition (calibration, zone definition, detection settings, time settings, scheduler…)
2. Open the Data acquisition panel
3. Start recording the video of the experiment without animal by pressing the Start recording button available on the SMART player.
4. Put the animal into the experimental area
5. Start the data acquisition process by pressing the Start button of the Time control panel.
6. The tracking process will be carried out simultaneously to the recording process.
7. Wait the end of the tracking process or press the Stop button on the Time control panel.
8. Remove the animal from the experimental area.
9. Stop the video recording process by pressing the stop button available on the SMART player
10. Prepare the experimental area to the next animal (washing, drying…)
11. Repeat the cycle again…

This procedure cannot be applied when using SMART with the external recording devices such as RECORD-IT1USB, RECORD-IT1 or RECORDIT4 to 8 solutions.

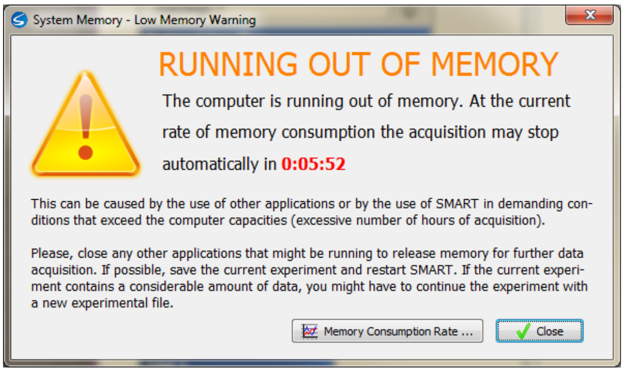
13.10. Computer resources monitoring

SMART automatically monitors the computer's resources during data acquisition in order to avoid undesirable data loss.

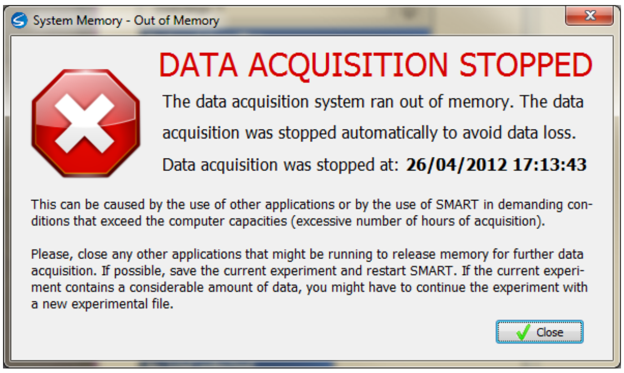
If the RAM memory reaches critical levels, SMART warns you with the following message:



This message will automatically disappear if memory level is restored again but, if the critical situation persists and gets worse, SMART automatically will stop the running trials in all arenas.



In this case, the following message is shown including the time and date at which the trials were stopped and a log file is generated within the SMART installation folder.



13.11. Data backup

SMART has a built-in automatic data backup system designed to prevent the experimental data loss, especially in conditions in which long data acquisition sessions (several hours) are executed.

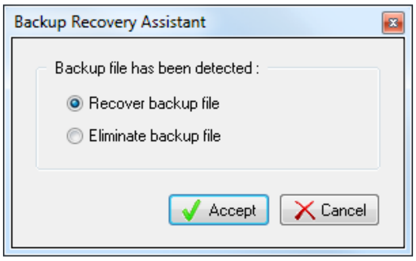
During these hours a problem with the operating system or a power feeding failure could ruin all the data acquired since the problem occurred. To minimize this undesirable condition, the backup system is periodically and transparently launched every 5 minutes and stores a copy of all the information in the experiment file: from the configuration to the data acquired during the acquisition process.

The system generates a pair of files called *Experiment.~bak* and *Experiment.ldb* to store the backup information.

DO NOT remove these files unless you are absolutely sure that they are no longer needed.

As the backup system is launched every 5 minutes (and not sooner), the configuration made and the information acquired during the last 5 minutes may be lost if the system crashes. If that information is critical for your needs, make sure to save the file manually in a shorter period of time.

In case of a computer or software crash, the backup system will detect the incident during the following execution of the software and will provide a mechanism to recover or definitely discard the backed-up information.



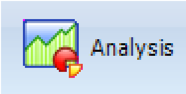
If the **Recover backup file** option is selected, the backed-up information will be automatically recovered and opened as a new experiment file. Thus, you must to save the new file manually.

If the **Eliminate backup file** option is selected, the backed-up information will be deleted.

Select this option only if you are absolutely sure that the backed-up information is no longer useful. Please confirm with other users whom the use of SMART is shared to avoid loss of data belonging to others.

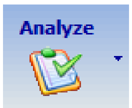
14. Data analysis

14.1. Accessing the analysis tool



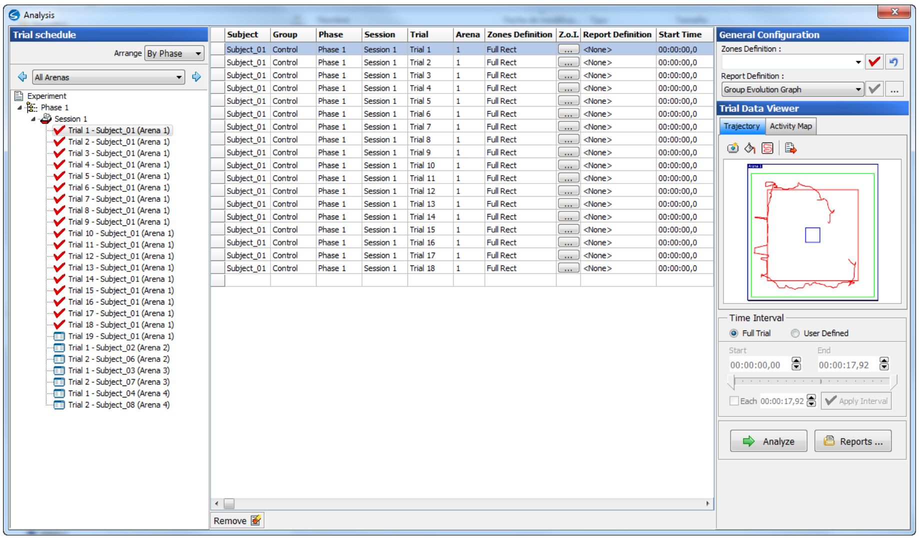
Analysis is the process of obtaining numeric and graphic reports from a list of finished trials and a specific configuration. To access the Analysis tool, press the **Analysis** button in the **Experimentation Assistant** bar.

The Analysis tool is not available when a data acquisition process is running. Wait until all the trials finish before accessing the Analysis tool.



The **Starting Assistant** launched when SMART is executed also provides a specific **Analyze** button to open an experimental file and access the analysis process immediately.

This is the main window of the analysis process:



To generate analysis reports, the next steps have to be followed:

1. Select the trials to analyze.
2. For each trial or block of trials:
    1. Select the zone definition and zones/associations of interest.
    2. Select the subject of interest (only for SMART-SI)
    3. Configure and select the analysis report.
    4. Set the time intervals to be analyzed.
3. Generate and review the reports.
4. Export the results to Excel or to image formats.

14.2. Modules and extensions license

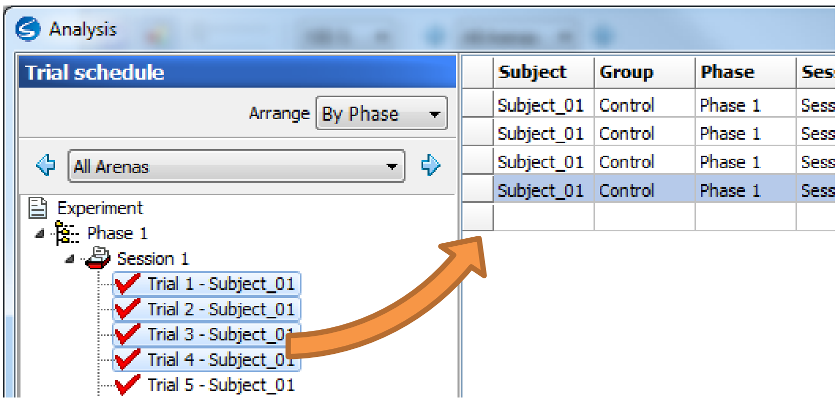
In order to adapt the analysis capabilities to the modules and extensions licensed, the SMART analysis module combines two different elements:

- The SMART USB protection key: if plugged (remember that it is not needed having a protection key plugged to analyze data), SMART will consider the modules and extensions licensed in the key.

- The selected trials: SMART will also consider as active every module and extension that was active when the selected trials were executed, independently on whether the modules are or not active in the present protection key (if connected).

14.3. Selecting the trials to be analyzed

The trials to be analyzed must be dragged from the **Trial schedule** section of the **Analysis** panel to the main list located in the center of the window.

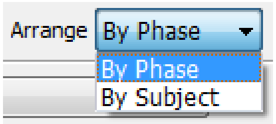


A unique trial, a group of selected trials, a session (all trials of the session will be included) or a phase (all trials in all sessions of the phase will be included) can be dragged.

SMART-MA

An "Arena selector" control is provided for SMART-MA users within the **Trial schedule** section in the **Analysis** panel. Select the arena with the selector to view the list of trials belonging specifically to that arena.

The "Arena selector" control in the **Analysis** panel provides an exclusive option called "All Arenas" to facilitate selecting trials acquired in different arenas.



The trials in the **Trial schedule** section can be arranged in two different ways:

- By Phase: the trials' tree is arranged in an experiment-phase-session scheme. This option facilitates selecting multiple trials acquired in the same session and thus analyzing the evolution of a group of subjects.

- By Subject: the trials' tree is arranged in an experiment-subject-phase-session scheme. This option facilitates selecting the trials in which a specific subject participated and thus analyzing the evolution of this subject in particular.

The trials selected to analyze are automatically included into the main table of the **Analysis** panel showing the following information:

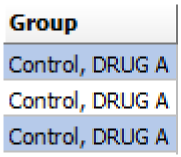
- **Subject**: code that the subject that participated in the trial had when the trial was acquired.

  When several subjects belong to the same trial (**SMART-SI** social interaction experiments), the names of all the subjects participating to the trial are shown in the same box.

Subject
Mice_01, Mice_06
Mice_02, Mice_07
Mice_04, Mice_10

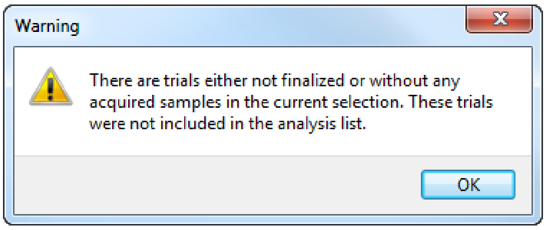
- **Group**: group to which the subject that participated in the trial belonged when the trial was executed.

When several subjects belong to the same trial (**SMART-SI** social interaction experiments), the group of all the subjects participating to the trial are shown in the same box.



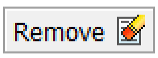
- **Phase**: name of the phase in which the trial has been registered.
- **Session**: name of the session in which the trial has been registered
- Trial: name of registered the trial and defined in the **Scheduler**.
- **S.o.I** (Subject of Interest): Subject filter used for selecting the subject of the trial that will be considered in the analysis This option is only available when the **SMART-SI** module is activated or when the trial has been registered with more than 1 subject (social interaction experiments)
- **Arena**: number of the arena in which the trial was registered.
- **Zones Definition**: name of the zones definition in which the trial will be analyzed. The zones definition used during data acquisition is selected by default.
- **Report Definition**: name of the report that will be applied on that trial.
- **Start Time**: start time of the analysis. By default, this Start time is set to zero.
- **End Time**: end time of the analysis. By default, the End time matches with the trial total duration.
- **Interval Time**: duration of the subintervals that will be considered during the trial analysis. By default, it matches with the trial total duration so that a single subinterval is evaluated.

Please note that a trial without any information acquired cannot be dragged to the main table. In that case, a warning message is shown:



In order to remove a group of trials selected to analyze:

1. Select the trials in the table using the combination of the mouse clicks and the [SHIFT] / [CTRL] keys.
2. Press the **Remove** button located at the bottom left corner of the table.



14.4. Analyzing the same trial with different conditions

A particular trial can be analyzed multiple times using different conditions (zones definition and report definition). To do that:

1. Drag and drop the trial (or selected trials) several times to the analysis grid.
2. Apply the particular zones definition, zones and associations of interest and report definition to every trial independently. Please refer to the next chapters in this section for more details on how to apply a specific analysis configuration to a trial.

Subject	Group	Phase	Session	Trial	Arena	Zones Definition	Z.o.I.	Report Definition
Subject_01	Control	Phase 1	Session 1	Trial 1	1	Full Rect	...	Summary Report
Subject_01	Control	Phase 1	Session 1	Trial 2	1	Full Rect	...	Summary Report
Subject_01	Control	Phase 1	Session 1	Trial 3	1	(Default) Rect : Cer	...	Activity Episode List
Subject_01	Control	Phase 1	Session 1	Trial 4	1	(Default) Rect : Cer	...	Activity Episode List
Subject_01	Control	Phase 1	Session 1	Trial 5	1	Full Rect	...	Event List

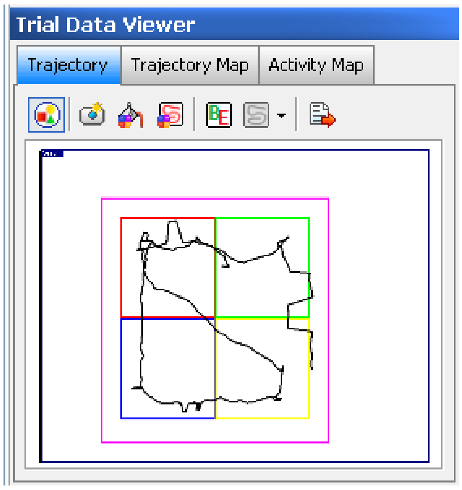
14.5. The trial data viewer

Whenever a trial is selected in the table, the **Trial Data Viewer** section is automatically updated to show a summary of the information acquired, that is, the trajectory and/or the activity map (depending on the detection mode selected before executing the trial).

When several trial are selected, the Trail Data Viewer shows the view corresponding to the first trial selected.

14.6. Trajectory viewer

The **Trajectory** viewer is only available when one of the Tracking detection modes was used for registering the data of the selected trial.



The following tools are provided:

 Shows or hides the zones definition.

 Shows or hides the background image captured before acquiring the track.

 Allows setting a solid background color.

 Allows setting a color to draw the trajectory trace.

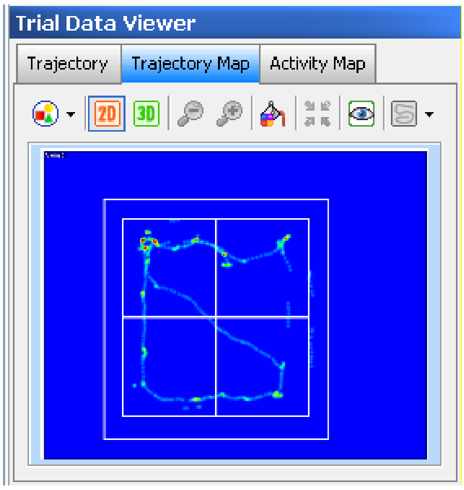
 Shows or hides begin and end tags.

 When there are trajectory traces of several subjects, it opens a drop-down list that allow to select visualization of all trajectory traces or the individual trajectory trace or each subject.

 To export the current track view to a bitmap file.

14.7. Trajectory MAP viewer

The **Trajectory Map** viewer is only available when one of the Tracking detection modes was used for registering the data of the selected trial.



The following tools are provided:

 Shows or hides the zones definition. The zones can be shown in their original colors or in white.

 Allows visualization of the trajectory map in 2D.

 Allows visualization of the trajectory map in 3D.

 If viewing the map in 3D, it is possible to rotate the map by dragging the map with mouse. In that case it is also possible to zoom in and out the 3D view of the activity map by using the **Zoom in** and **Zoom out** buttons.

 Allows setting a solid background color.

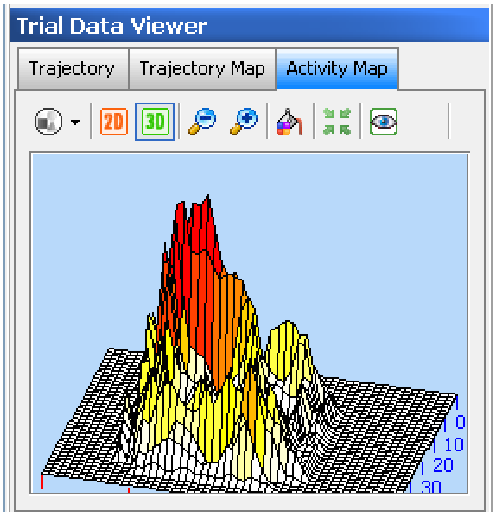
 The 3D view may be restored by using the **Reset 3D map** button

 Allows visualization of the trajectory map with greater details and export the image and the raw data to external files.

 When there are trajectory traces of several subjects, it opens a drop-down list that allow to select visualization of all trajectory traces or the individual trajectory trace or each subject.

14.8. Activity Map viewer (SMART-GA)

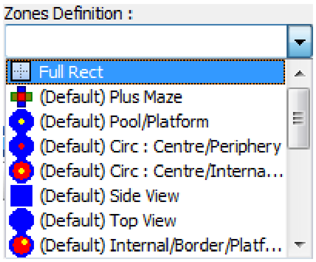
The **Activity Map** viewer is only available when the Activity detection mode (SMART-GA) was used for registering the data of the selected trial.



The activity map shown in the **Trial Data Viewer** provides the same functionalities as the runtime panel available during the data acquisition process.

Please refer to page 197 for more details on the tools provided within the **Activity Map** panel to publish the results.

14.9. Selecting the zones definition



Although the data acquisition process was done using a particular zone definition, the data can be analyzed again using a different one for each individual trial.

In order to change the analysis zones definition to consider please follow these steps:

1. Select the trials in the grid to which the zones definition will be reassigned. Use the [CTRL]+Click combination to select multiple individual trials, [SHIFT] + Click to select a block of contiguous trials, or [CTRL] + [A] to select all of them.
2. Select the desired zone from the list **Zone definition** which is located in the right top side of the analysis window. When a zone definition is selected, it is shown in the **Trial Data Viewer** area which also shows the trajectory followed by the subject during the first selected trial and its activity map.
3. Click the button to assign the selected zone to the selected trials. The Zone Definition column of the selected trials in the grid is updated with the selected list zone.

SMART-GA

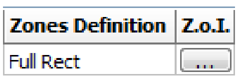
If the global activity information was acquired and the zone definition to be applied is different as the one used during the data acquisition, the global activity per zone cannot be calculated.

The original acquisition zone of the selected trials may be restored at any time by clicking the button.

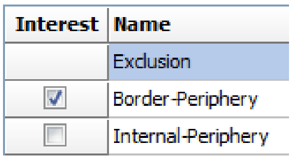
14.10. Zones and associations of interest

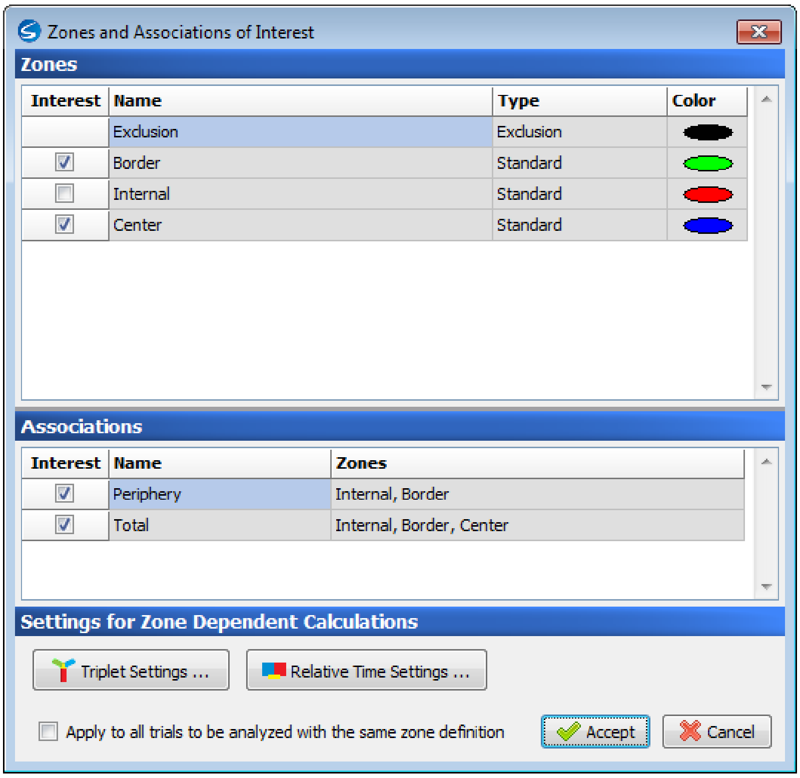
SMART-CS

Only if the SMART-CS module is enabled, the **Zones/Assoc. Management** tool already described in the chapter 7.2.5 is provided during the analysis process.



Additionally, to the zones definition, the included zones and associations of interest that will be considered during the analysis process can be also selected. To do that, a specific tool is provided through the button located in the **Z.o.I.** (Zones of Interest) column.





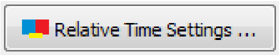
The list of zones and associations defined within the selected zones definition is shown in the **Zones** and **Associations** sections of the panel.

Except the *exclusion* zone (which is always considered during the analysis), the rest of zones and associations are automatically selected. Uncheck the box of any zone or association if you want to discard the partial calculations done for that zone/association during the analysis process.

Even if the analysis stop condition is based on the entries or permanence time on a particular zone and this zone is not selected as of-interest, the stop condition will be evaluated as usual.

SMART-CS

Some specific calculations are closely related to the zones defined and depend on the names given to them. One example of this case is the *triplet* calculation, which is a common measure within the T-Y Maze paradigm.



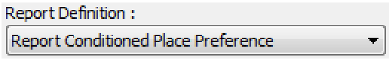
The **Triplet Settings** button provides a tool to select the zones of your particular definition that must be considered to assess the *alternations triplet* calculation. Please refer to the chapter 15.3.1.3 for more details on the *alternations triplet* calculation and its application within the T-Y Maze paradigm.

Another example is the calculation of the **Relative Time** in the compartment in a conditioned place preference experiment. Please refer to the chapter 0 for more details.

If multiple trials were selected in the analysis grid before showing the **Zones or Associations of Interest** panel, check the **Apply to all trials...** box to apply your new settings regarding the zones or associations of interest to all the trials selected that have the same zone definition applied.

14.11. Selecting and configuring the report

SMART is able to generate a wide variety of analysis reports depending on the protocol and particular requirements desired. Each report definition implies a different content and arrangement of the analysis results and a specific analysis configuration also.



Each experimental module provides you with a standard report definition that fulfills the basic needs on your specific paradigm. Select it in the **Report Definition** list of the **General Configuration** section to get the proper results.

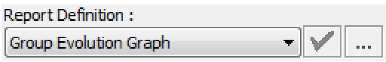
Please refer to the chapter 14.11.2 for more details on the structure and content of the standard report definitions provided by each experimental module.

SMART-CS

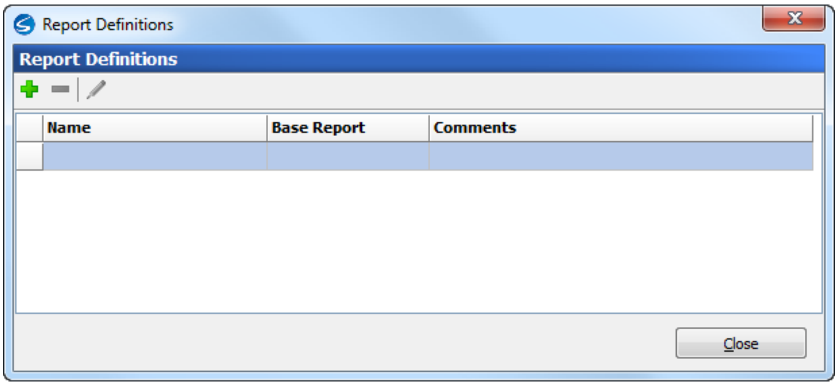
SMART-CS users are provided with a **Report Definitions Manager** tool that enables users to freely design analysis reports and configure the analysis process independently. Moreover, each trial can be analyzed using a different report definition.

The rest of this chapter applies only for SMART-CS users.

14.11.1. Managing analysis report definitions



When a Customized experimental file is analyzed, a **Report Definition Manager** tool is provided through the ... button located at the right side of the **Report Definition** list.



The **Report Definitions Manager** tool shows the list of the analysis reports already defined in the experimental file. The following information is provided for each definition:

- Name: the user defined name of the report.
- Base report: the name of the standard base report definition used to create the new definition.
- Comments: additional information regarding the report definition.

14.11.2. Base reports

Every new report definition must be based in the structure of an already existing *base report*.

A particular base report determines the tabular structure of the information and also the calculations provided to generate the analysis reports.

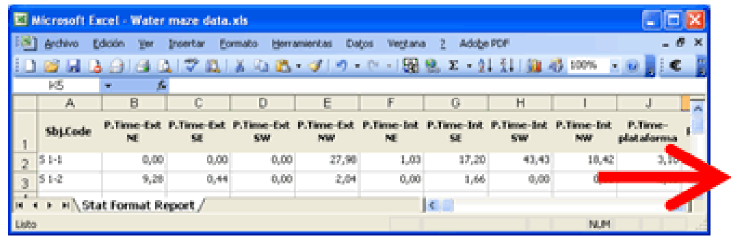
SMART provides the following base reports to cover a variety of reporting needs.

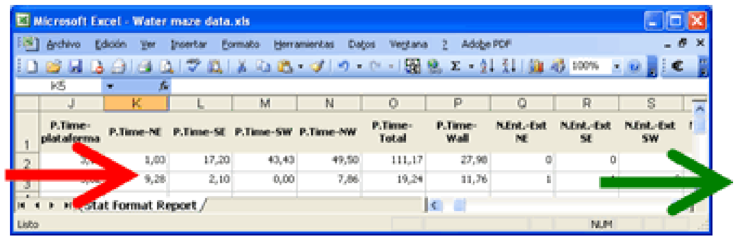
14.11.2.1. Summary report

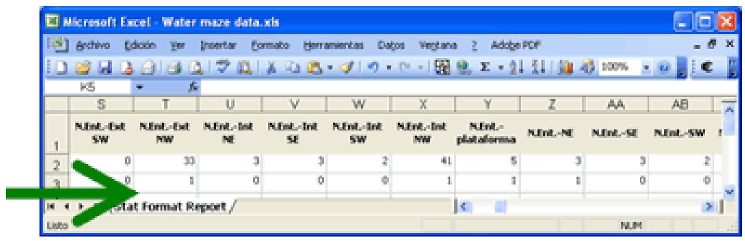
When data will be exported to a 3rd party statistical software package (SPSS, StatView, SigmaStat, Statistica or similar), using the Summary Report will save time.

The resulting report is arranged with one row per trial (meaning one row per subject).

When different zones and interval of time are configured, the parameters calculated for each zone and interval time are represented in different columns (see next figures as example).







14.11.2.2. Event list

Provides a list and time distribution of the events registered manually via the **Event Marker** tool. Please refer to the chapter 13.4 for more details on how to record events.

The following calculations are included within the Event List report:

- Event Index Nr.
- Event Rel. Time (Seconds)
- Event Rel. Time (HH:MM:SS,00)
- Event System Time.
- Event Name.
- Event Duration (Seconds).
- Event Zone START.
- Event Zone END.

Please refer to the chapter 15.3.4 for more details on the meaning of these calculations.

14.11.2.3. Speed episode list

Provides a list of the speed status episodes automatically detected and registered by SMART and sorted chronologically.

The following calculations are included within the Speed Episode List Report:

- Episode Index Nr.
- Episode Rel. Time (Seconds)
- Episode Rel. Time (HH:MM:SS,00)
- Event Name.
- Episode Duration (Seconds).
- Episode Zone START.
- Episode Zone END.

Please refer to the chapter 15.3.11 for more details on the meaning of these calculations.

14.11.2.4. Activity episode list (SMART-GA)

SMART-GA users are provided with this base report which generates a list of the activity episodes automatically detected and registered by SMART sorted chronologically.

The following calculations are included within the Activity Episode List report:

- Episode Index Nr.
- Episode Rel. Time (Seconds)
- Episode Rel. Time (HH:MM:SS,00)
- Event Name.
- Episode Duration (Seconds).
- Episode Zone START.
- Episode Zone END.

Please refer to the chapter 15.3.5 for more details on the meaning of these calculations.

14.11.2.5. Zone transition list

The software provides a list and time distribution of the zone transitions automatically detected and registered by SMART.

The following calculations are included within the Zone Transition List report:

- Transition Index Nr.
- Transition Rel. Time (Seconds)
- Transition Rel. Time (HH:MM:SS,oo)
- Transition Current Zone.
- Transition Time in Zone.
- Accumulated Time.
- Entries Nr.
- Distance in Zone.

Please refer to the chapter 15.3.2 for more details on the meaning of these calculations.

14.11.2.6. Association transition list

The software provides a list and time distribution of the zone association transitions automatically detected and registered by SMART.

The following calculations are included within the Zone Association Transition List report:

- Transition Index Nr.
- Transition Rel. Time (Seconds)
- Transition Rel. Time (HH:MM:SS,oo)
- Transition Current Zone.
- Transition Time in Zone.
- Accumulated Time.
- Entries Nr.
- Distance in Zone.

Please refer to the chapter 15.3.3 for more details on the meaning of these calculations.

14.11.2.7. TriWise rearing list (SMART-TW)

SMART-TW users are provided with this base report which generates a list and time distribution of the rearing events automatically detected and registered by SMAR.

The following calculations are included within the Rearing List report:

- Rearing Index Nr.
- Rearing Rel. Time (Seconds)
- Rearing Rel. Time (HH:MM:SS,00)
- Event Name.
- Rearing Duration (Seconds).
- Rearing Zone START.
- Rearing Zone END.

Please refer to the chapter 15.3.5 for more details on the meaning of these calculations.

14.11.2.8. TriWise rotation list (SMART-TW)

SMART-TW users are provided with this base report which generates a list and time distribution of the rotation events automatically detected and registered by SMART.

The following calculations are included within the Rotation List report:

- Rotation Index Nr.
- Rotation Rel. Time (Seconds)
- Rotation Rel. Time (HH:MM:SS,00)
- Event Name.
- Rotation Duration (Seconds).
- Rotation Zone START.
- Rotation Zone END.

Please refer to the chapter 15.3.7 for more details on the meaning of these calculations.

14.11.2.9. TriWise stretching list (SMART-TW)

SMART-TW users are provided with this base report which generates a list of the stretching events automatically detected and registered by SMART sorted chronologically.

The following calculations are included within the Stretching List report:

- Stretching Index Nr.
- Stretching Rel. Time (Seconds)
- Stretching Rel. Time (HH:MM:SS,00)
- Event Name.
- Stretching Duration (Seconds).
- Stretching Zone START.
- Stretching Zone END.

Please refer to the chapter 333 for more details on the meaning of these calculations.

14.11.2.10. Relative position Event list (SMART-SI)

SMART-SI users are provided with this base report which generates a list of the social interaction events automatically detected and registered by SMART sorted chronologically.

The following calculations are included within the Relative position event List report:

- Rel. Pos. Index Nr.
- Rel. Pos. Rel. Time (Seconds)
- Rel. Pos. Rel. Time (HH:MM:SS,00)
- Event Name.
- Rel. Pos. Duration (Seconds).
- Rel. Pos. Avg. Distance
- Rel. Pos. Min. Distance
- Rel. Pos. Max. Distance
- Rel. Pos. Contact Points
- Rel. Pos. Type
- Rel. Pos. Subj. A Name
- Rel. Pos. Subj. B Name
- Rel. Pos. Subj. A Zone START.
- Rel. Pos. Subj. A Zone END.
- Rel. Pos. Subj. B Zone START.
- Rel. Pos. Subj. B Zone END.

Please refer to the chapter 15.3.9 for more details on the meaning of these calculations.

14.11.2.11. Track Coordinates Report

Provides a list of all the recorded coordinates of each subject for every sample.

The following calculations are included within the Track Coordinates Report:

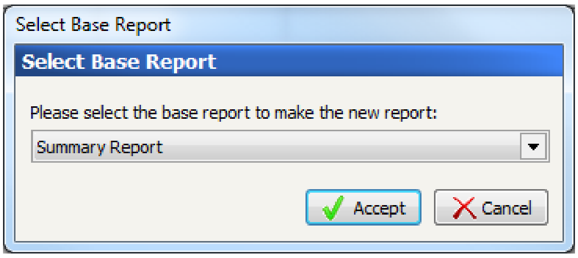
- Sample Index Nr.
- Sample Time (Seconds)
- Sample Time (HH:MM:SS,oo)
- X Coordinate
- Y Coordinate
- Distance Between Subjects
- Relative Position Between Subjects
- Sample Zone
- Vector Angle (Degrees)
- Vector Angular Speed (Degrees/Second)
- Parallel Index
- Turning Tendency
- Segment Angle (Degrees)
- Segment Length.
- Speed
- Speed Status

Please refer to chapter 15.3.10 for more details on the meaning of these calculations.

14.11.3. Creating and editing a report definition

To create a new report definition:

1. Press the **+** button located in the toolbar of the panel.
2. Select a base report definition to make the new report. Then press the **Accept** button.
3. Enter the report name and comments of the new report definition.

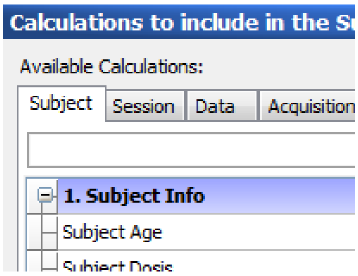


To edit an already existing report definition:

1. Select the report definition to edit in the table and press the **Pen** button located in the toolbar of the panel.

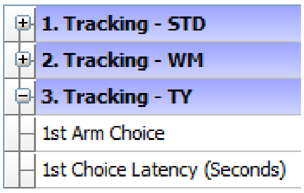
   Alternatively, making a double click on the report definition's row in the table has the same effect.
2. Enter the new report name and comments.

14.11.3.1. Selecting the calculations



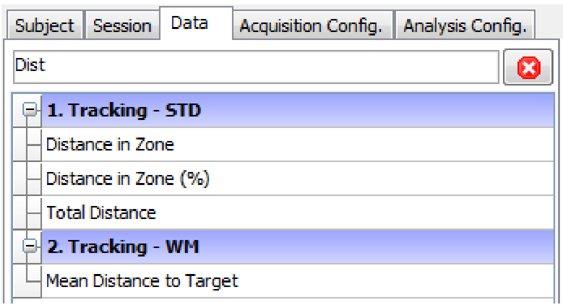
Select the calculations to be included in the report from the **Available Calculations** section:

1. Select the tab (section) to which the calculations belong:
   - **Subject**: contains all the subject's properties configurable within the **Subject Database** tool.
   - **Session**: contains useful information regarding the experiment and trials.
   - **Data**: contains the main tracking, event and global activity calculations arranged.
   - **Acquisition Config.**: contains the information related to the calibration, detection settings and time settings used during the data acquisition process.
   - **Analysis Config.**: contains the information related to the thresholds, zone definition, timing configuration and filters applied to generate the analysis reports.



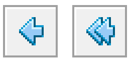
2. Navigate through the calculation groups belonging to the selected section. Sections can be stretched and expanded by using the [-] and [+] buttons located in the first column of the table.

   Alternatively, enter a portion of the name of the desired calculations in the **Search calculation** text box to filter all the calculations matching that portion of text. Clean the filter again using the button.

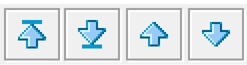


3. Select all the calculations that will be included in the analysis report by using the combination of [CTRL] / [SHIFT] keys and the mouse's left button.

4. Use the right-arrow buttons to move the selected calculations/all calculations to the **Included Calculations** list.



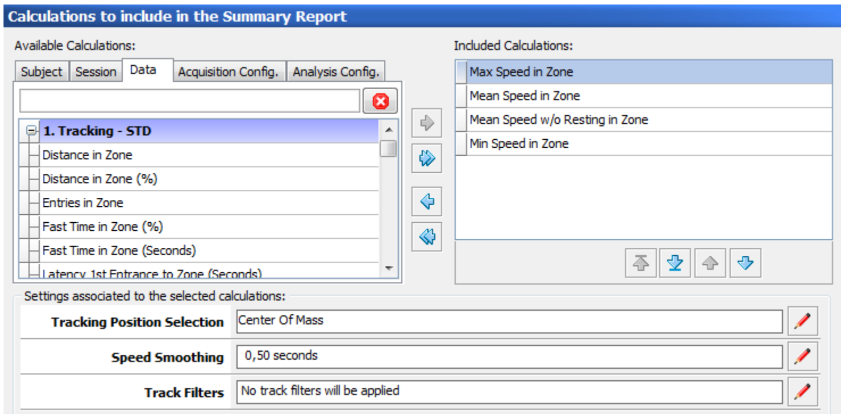
   If an already included calculation should be removed, select it and use the left-arrow buttons.



5. Sort the **Included Calculations** list by selecting a calculation and using the top/down-arrows to move along the list.

14.11.3.2. Configuring the calculations

Configure the included calculations with their associated settings:



1. Select a calculation within the **Included Calculations** list. The settings associated to the calculation are shown just below the **Available Calculations** list.

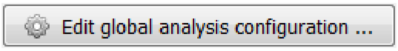
2. Global settings associated are accompanied by a **Pen** button. Press it to access the corresponding configuration panel.

   When a global setting is adjusted, all the calculations that use it are automatically updated with the new setting.

   Individual settings associated are accompanied by a **Tick** button. Edit the value directly in the textbox and press the button to accept the new setting.

   Individual settings only apply to the selected calculation and do not affect any other calculation.

14.11.4. Global analysis configuration

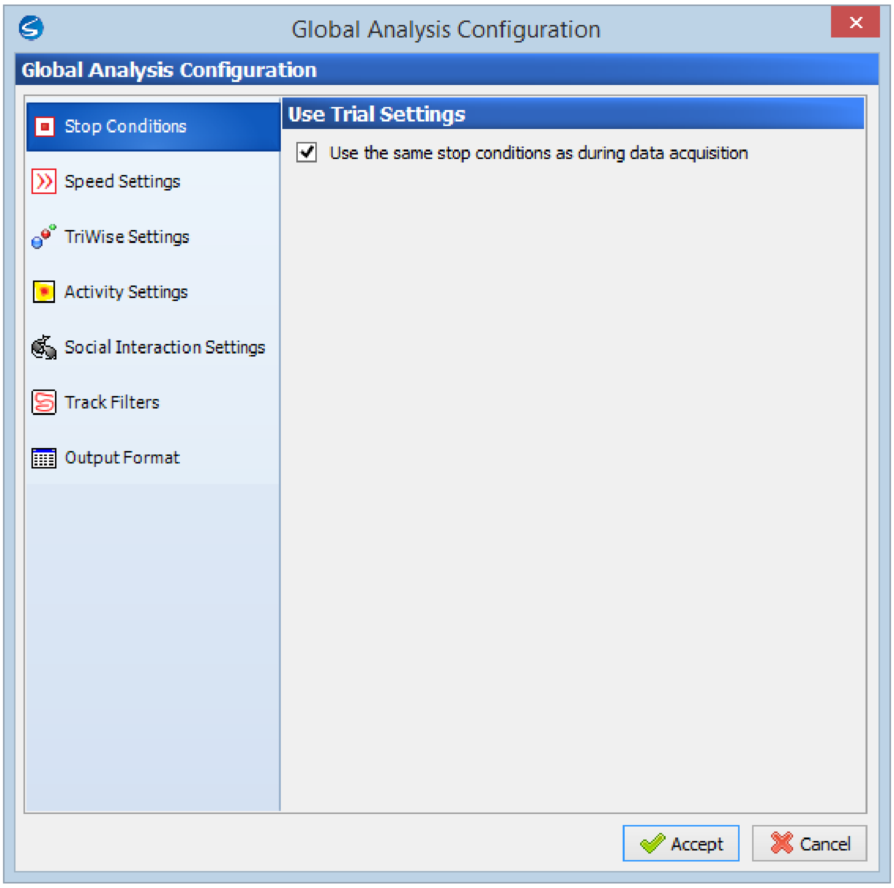


Some calculations arranged during the analysis process can be adjusted through the **Analysis configuration** panel. This panel is accessed by mean of the **Edit global analysis configuration** button.

SMART-CS

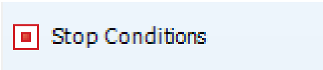
SMART-CS users are provided with a **Report Definitions Manager** tool explained previously in chapter 14.11.

When a customized experiment is analyzed, the global analysis configuration takes part of the report definition itself so each trial can be analyzed under different global configurations. That is why the **Analysis configuration** panel is accessed within the **Report Definition** panel explained in chapter 14.11.2.

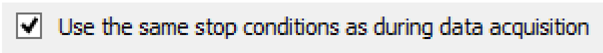


The menu on the left shows the available sections of the analysis settings that can be edited. The following settings can be changed for analysis (depending on the modules and extensions enabled during the trial's data acquisition process):

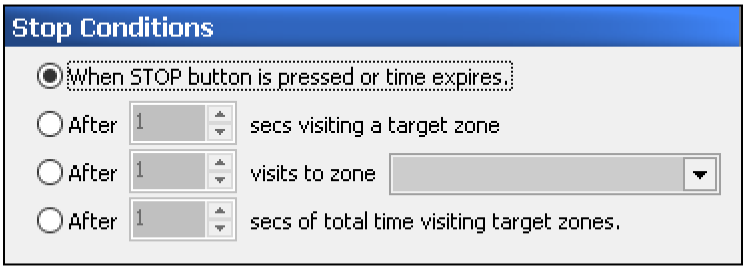
- Stop Conditions
- Speed Settings
- Activity Settings
- TriWise Settings
- Social Interaction Settings
- Track Filtering and smoothing
- Format of the output reports



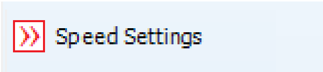
14.11.4.1. Stop condition



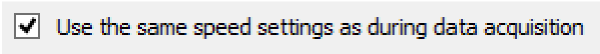
If the box **Use the same stop conditions as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different stop conditions for analysis, uncheck this box. Please refer to the chapter 9.4 for more details on how to set the new stop condition for the analysis process. Note that the "Arena Selector" tool is not available in this case as every trial is analyzed independently.



If the stop condition cannot be applied to all the trials (e.g. the target zone selected does not exist in the zones definition used in some trials) then it will not be evaluated. In these cases, the analysis process will not stop until the end of the trial's data.

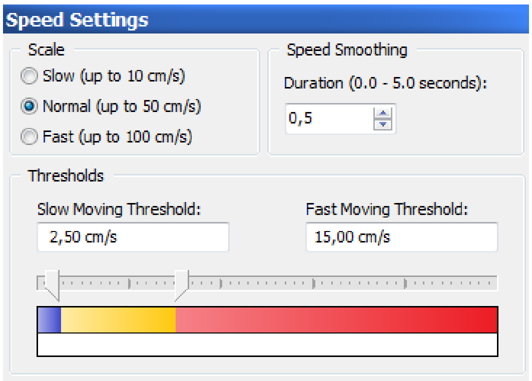


14.11.4.2. Speed settings



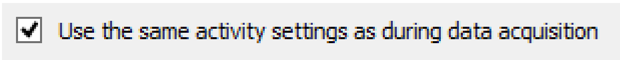
If the box **Use the same speed settings as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different speed settings for analysis, uncheck this box.

The speed thresholds for all the selected trials can be adjusted whenever tracking data was acquired (e.g. FST/TST trials do not acquire tracking data).



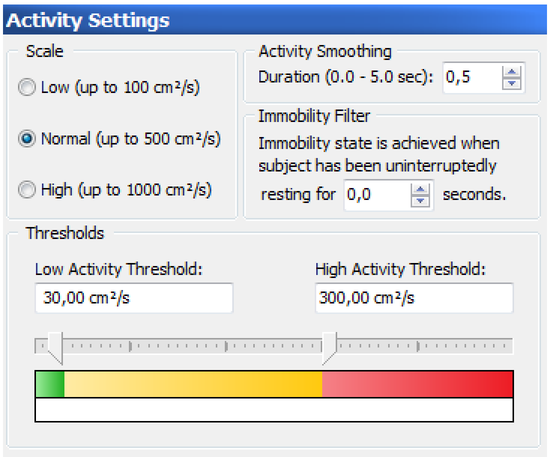
Please refer to the chapter o for more details on how to set the new speed settings for the analysis process. Note that the "Arena Selector" tool is not available in this case as every trial is analyzed independently.

14.11.4.3. Activity settings (SMART-GA)

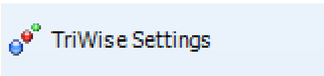


If the box **Use the same activity settings as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different activity settings for analysis, uncheck this box.

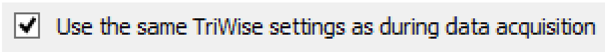
The activity thresholds for all the selected trials can be adjusted whenever activity data was acquired or the SMART-GA extension was purchased and is active in the current license key.



Please refer to the chapter 0 for more details on how to set the new speed settings for the analysis process. Note that the "Arena Selector" tool is not available specifically in this case as every trial is analyzed independently.



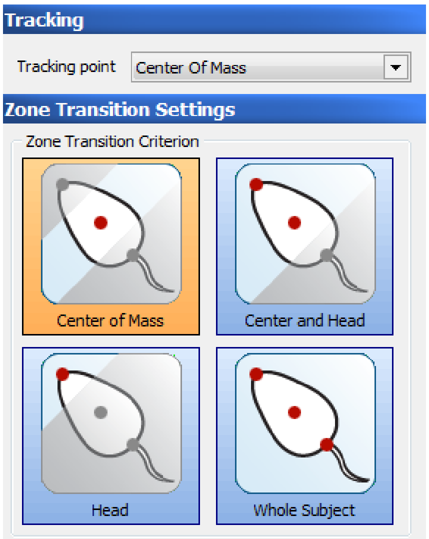
14.11.4.4. TriWise settings (SMART-TW)



If the box **Use the same TriWise settings as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different TriWise settings for analysis, uncheck this box.

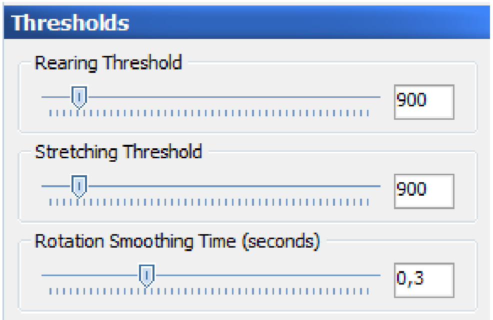
The TriWise thresholds for all the selected trials can be adjusted whenever TriWise data was acquired or the SMART-TW extension was purchased and is active in the current license key.

Please refer to chapter 8.2.3.3 for more information about how to configure the **Tracking Point** and the **Zone Transition Criterion**.

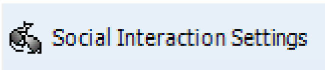


Please refer to the chapter 13.3.1.2 for more details on how to set the new zone transition, rearing, rotation and stretching settings for the analysis process.

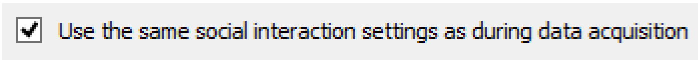
The panel is provided with a threshold selector for Rearing, Stretching and Rotation smoothing time. These configurations are the same that were provided during the data acquisition process for the SMART-TW module.



Note that the "Arena Selector" tool is not available specifically in this case as every trial is analyzed independently.

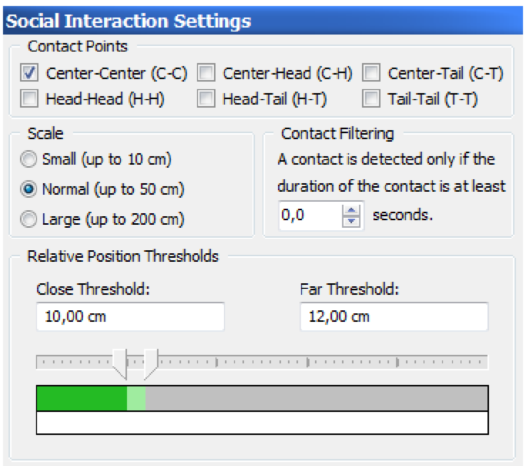


14.11.4.5. Social Interaction Settings (SMART-SI)



If the box **Use the same social interaction settings as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different social interaction settings for analysis, uncheck this box.

The social interaction settings for all the selected trials can be adjusted whenever a trial has been acquired with multiple subjects or the SMART-SI experimental module was purchased and is active in the current license key.

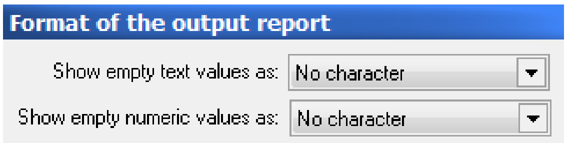


Please refer to the chapters o for more details on how to set the Social Interaction settings for the analysis process. Note that the "Arena Selector" tool is not available specifically in this case as every trial is analyzed independently.

Output Format

14.11.4.6. Format of the output reports

The following options are provided to adjust the content of the reports when the values cannot be evaluated or calculated properly (in some cases, this is not applicable) during the analysis process.



Different options are provided for text and numeric values.

Track Filters

14.11.4.7. Filtering and smoothing techniques in SMART

If the box **Use the same track filter settings as during data acquisition** is checked, the analysis process will use the settings used during the data acquisition process of every trial. To specify different track filter settings for analysis, uncheck this box.

Due to the nature of video-tracking systems, some image noise could appear and is typical:

- Outliers: momentary observations that are away from other neighboring (in time) increase dramatically the distance travelled and the mean speed.
- Body wobble: movements like head scanning or shifts of body weight, even when the animal does not progress at all, might affect the position of its center and, consequently, the measured distance and speed.
- Accumulated error: little variations of the center of mass could imply a considerable error in the total distance travelled.
- Mislead stop detection: oscillations of the measured speed producing a poor detection of a stop and the stop's duration.

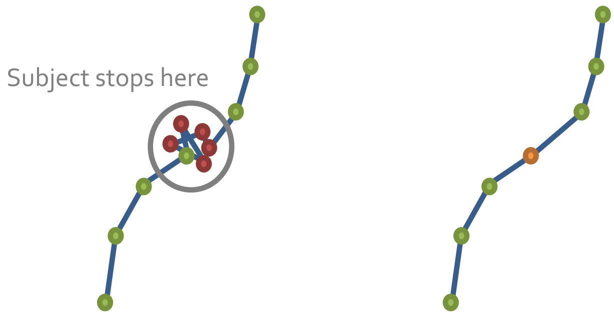
SMART provides a variety of filtering and smoothing algorithms to substantially improve the precision of the analysis calculations avoiding all these effects.

Please note that applying filters to the acquired trajectory may drastically impact the final results if they are compared with the results shown in the **Runtime Viewer** panel.

Filters and smoothing lead to a different set of position samples (trajectory) and thus a different list of zone entries, permanence time, speed ranges, immobility episodes and, ultimately, stop conditions.

Anti-vibrations filter

Periods in which the subject's displacement is slower than the configured speed will be automatically ignored so that the animal is considered to be "static" and thus the total distance travelled is not accumulated.



The previous image shows an example of how several erratic samples are generated by a poor image's quality during the data acquisition process when the subject stops. The anti-vibrations filter automatically corrects them by a long-duration stop without displacement (zero speed).

Drag and drop the marker to set your particular speed value for the anti-vibrations filter. Click on the marker and use the [LEFT] and [RIGHT] arrow keys to refine the value.

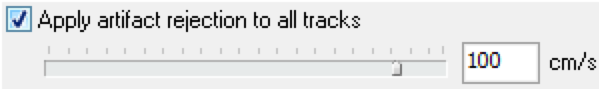
Please note that setting the anti-vibrations filter too high can cause the system to ignore a real movement of the subject between consecutive frames, resulting in speed values that are not accurate.

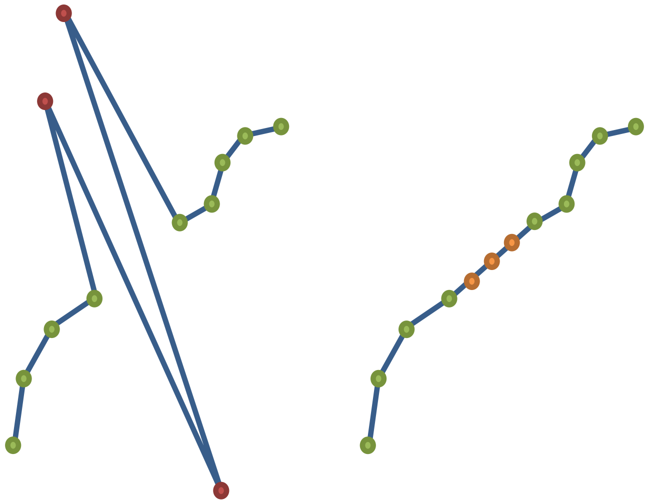
Rats and mice are usually displaced at 5-10 cm/sec (2-4 inches/s) so an anti-vibration filter lower than 1 cm/s (0.5 inches/s) would be suitable. The maximum intensity of the filter is 25 cm/s (25 inches/s) so that a wider range of experimental conditions are covered.

This filter is adjusted as a speed value; therefore, the calibration process must be correctly completed before the filter can be utilized. Please refer to the chapter 6 for more details on how to calibrate the video-tracking process.

Artifact rejection filter

Periods in which the subject's displacement is faster than the configured speed will be automatically corrected by a lineal interpolation of the subject's positions.





The previous image shows an example of how some erratic samples generated by an artifact during the data acquisition process are automatically corrected by linear interpolation of the anti-artifacts filter.

Drag and drop the marker to set the particular speed value for the anti-artifacts filter. Click on the marker and use the [LEFT] and [RIGHT] arrow keys to refine the value.

Please note that setting the anti-artifacts filter too low can cause the system to artificially interpolate a real smooth movement of the subject between consecutive frames, resulting in speed values that are not accurate.

Rats and mice are usually displaced at 5-10 cm/sec (2-4 inches/s) so an artifact rejection filter higher than 25 cm/s (10 inches/s) would be suitable. The maximum intensity of the filter is 110 cm/s (110 inches/s) so that a wider range of experimental conditions are covered.

This filter is adjusted as a speed value; therefore, the calibration process must be correctly completed before the filter can be utilized. Please refer to the chapter 6 for more details on how to calibrate the video-tracking process.

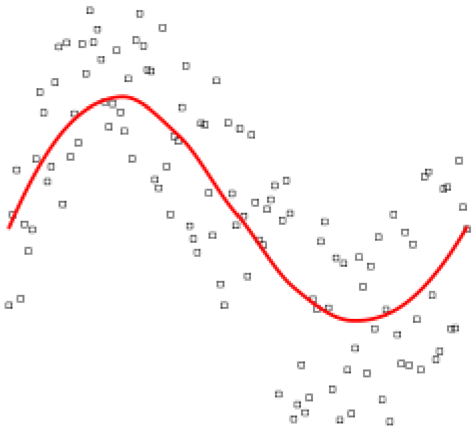
LOWESS smoothing algorithm

LOWESS (LOcally WEighted Scatterplot Smoothing) is a modern regression algorithm designed to generate a more smoothed and thus realistic trajectory of the subjects tracked with SMART.

LOWESS combines much of the simplicity of linear least squares regression with the flexibility of nonlinear regression. It does this by fitting simple models to the subject's trajectory to build up a function that describes the deterministic part of the variation in the data, point by point.

One of the main attractions of this method is that no specific user-configuration is required.

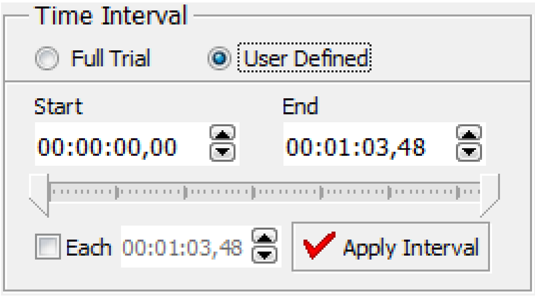
Because it is so computationally intensive, LOWESS cannot be executed during the data acquisition setting but only during the analysis process.



The previous image shows an example of how erratic samples generated by artifacts during the data acquisition process are automatically corrected by the LOWESS filter during the analysis process.

14.12. Setting the time intervals

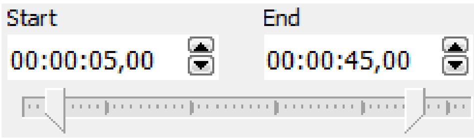
When the trials are inserted in the analysis grid, SMART automatically selects the full intervals to be analyzed. However, it is possible to change this for each trial or for a group of them at the same time.



To do this:

1. Select the trial or a group of trials in the list (using the [CTRL] and [SHIFT] keys combined with mouse clicks).
2. In the **Time Interval** section (located at the right bottom side of the analysis window), select the **User Defined** option.

3. Select the portion of the trial to be analyzed by selecting a START and END time by changing the text into Start/End boxes or by moving the markers along the available bar.



4. To splitting the calculation given each user-defined subintervals of time, check the **Each** box and enter the duration of the subintervals to be considered.

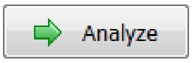
5. Press the **Apply Interval** button to apply the specified time interval settings to the selected trials.

Each subinterval will generate a new group of columns in the numerical analysis report. One additional column for each calculation evaluated by time intervals will be included. If the calculation depends on the zones / associations of interest, additional columns will be also included for each subinterval.

14.13. Generating the reports

Once the analysis process has been configured, the analysis reports can be generated in two different formats:

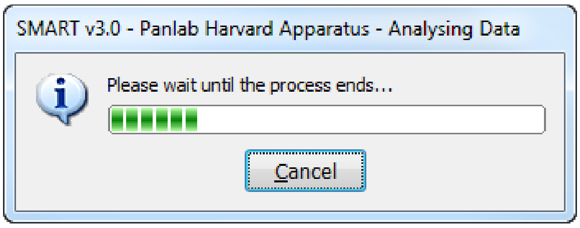
- **Numeric Reports**: for which a Microsoft® Excel® spreadsheet is generated including numerical results of the calculations.
- **Graphic Reports**: for which a visual plot is generated. This plot can be then exported to a file in BMP format.



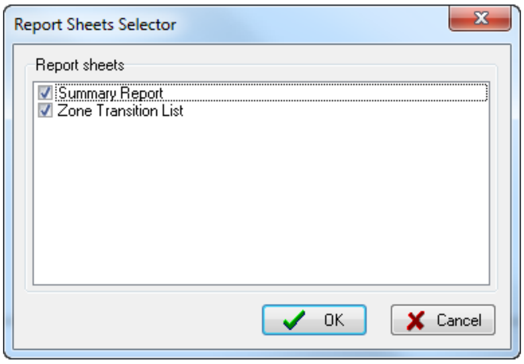
In any case, analysis report generation will start when the **Analyze** button (located in the bottom right-hand side of the analysis window) is pressed.

14.13.1. Numeric reports

When a numeric report is generated, a progress bar is shown indicating that the data is being analyzed:

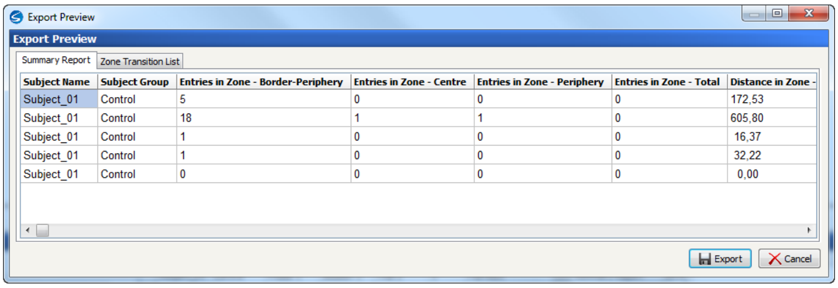


If more than one report definition was applied to the trials, a **Report Sheets Selector** tool is shown providing a way to select which of them will be considered.

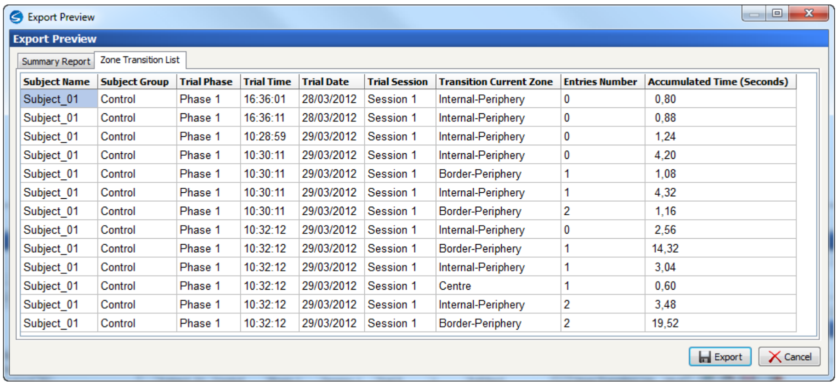


Check the boxes corresponding to the sheets that might be included in the report and press the **Ok** button.

An **Export Preview** window will be produced with all the information calculated during the analysis process and arranged among the selected sheets.



Subject Name	Subject Group	Entries in Zone - Border-Periphery	Entries in Zone - Centre	Entries in Zone - Periphery	Entries in Zone - Total	Distance in Zone -
Subject_01	Control	5	0	0	0	172,53
Subject_01	Control	18	1	1	0	605,80
Subject_01	Control	1	0	0	0	16,37
Subject_01	Control	1	0	0	0	32,22
Subject_01	Control	0	0	0	0	0,00

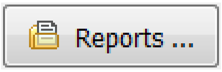


Subject Name	Subject Group	Trial Phase	Trial Time	Trial Date	Trial Session	Transition Current Zone	Entries Number	Accumulated Time (Seconds)
Subject_01	Control	Phase 1	16:36:01	28/03/2012	Session 1	Internal-Periphery	0	0,80
Subject_01	Control	Phase 1	16:36:11	28/03/2012	Session 1	Internal-Periphery	0	0,88
Subject_01	Control	Phase 1	10:28:59	29/03/2012	Session 1	Internal-Periphery	0	1,24
Subject_01	Control	Phase 1	10:30:11	29/03/2012	Session 1	Internal-Periphery	0	4,20
Subject_01	Control	Phase 1	10:30:11	29/03/2012	Session 1	Border-Periphery	1	1,08
Subject_01	Control	Phase 1	10:30:11	29/03/2012	Session 1	Internal-Periphery	1	4,32
Subject_01	Control	Phase 1	10:30:11	29/03/2012	Session 1	Border-Periphery	2	1,16
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Internal-Periphery	0	2,56
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Border-Periphery	1	14,32
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Internal-Periphery	1	3,04
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Centre	1	0,60
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Internal-Periphery	2	3,48
Subject_01	Control	Phase 1	10:32:12	29/03/2012	Session 1	Border-Periphery	2	19,52

The report can now be exported to Microsoft® Excel® by pressing the **Export** button. During the export, the user defines the file name.

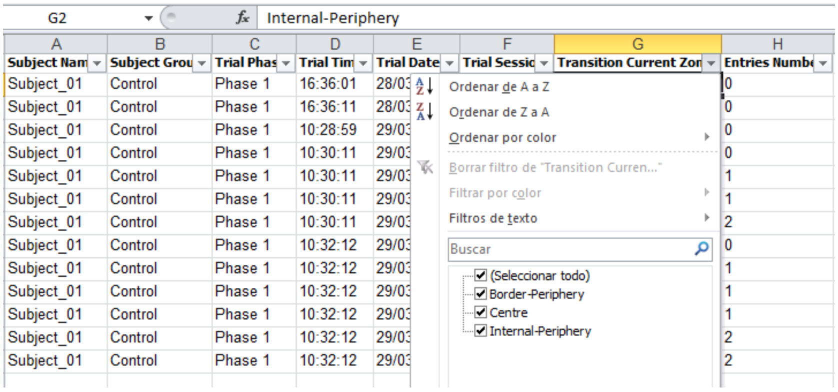
At least one Excel sheet is generated per each sheet selected to export. Additional sheets may be required if the number of columns exceed the limitations of Microsoft® Excel®.

SMART suggest saving the Excel® file under the "Report files" path configured in the system. Please refer to the chapter 12.1 for more details on how to configure the default paths.



The **Reports** button in the **Analysis** window gives a quick access to the folder in which the file was saved.

Information arranged in the file can be filtered using the auto filter option within Microsoft® Excel® to select what phase, session, subject, zone, etc. is to be reviewed.

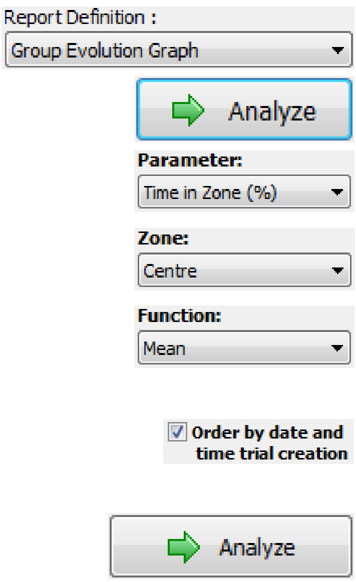


14.13.2. Graphic Reports: Group Evolution Graph

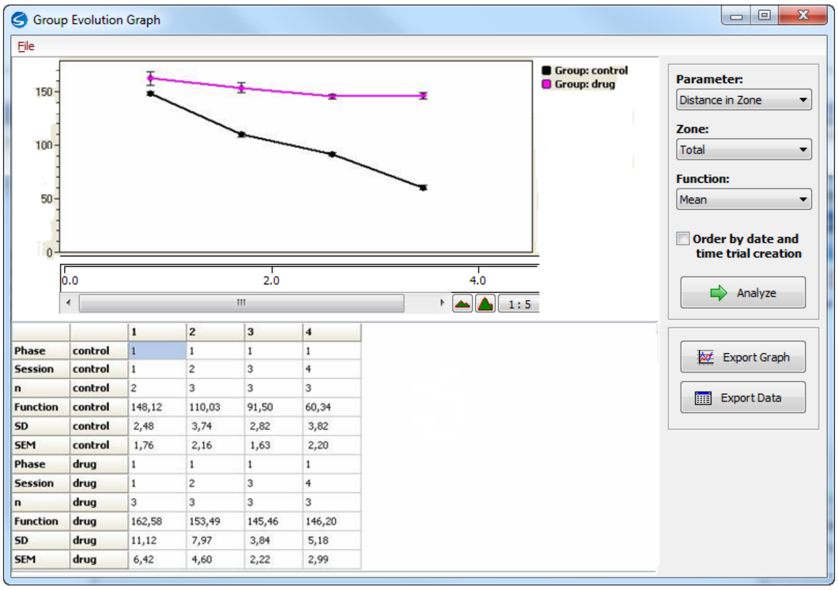
SMART group evolution graph is a useful tool to study the evolution of a parameter for a group of subjects and comparing with another groups.

The Group Evolution Graph only applies to the calculation available in the SMART summary reports.

To generate a group evolution graph properly:

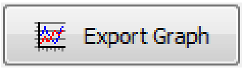


1. Select a set of trials carried out with subjects of different groups in different sessions within the experiment.
2. Apply the zones definition and intervals to analyze each trial.
3. Select the "Group evolution graph" option in the **Report definition** list of the analysis window.
4. Start the analysis process.
5. In the **Group Evolution Graph** window, select the parameter which evolution is to be studied.
6. Select the specific zone or association in which the parameter is to be evaluated.
7. Select the statistical aggregation function to be applied. This function will be applied to the values of the selected parameter calculated for all the subjects of the same group in a particular session.
8. Check "Order by date and time trial creation" option to sort the sessions from their date and time of creation. If the option is not checked, the order in which the trials were selected will be taken.
9. Press the **Analyze** button again to generate and preview the graph.

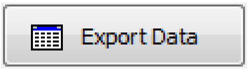


Each data series in the group evolution graph represents a different subject group within the selected trials. Each point represents the value of the aggregated function for each session and subject group. Standard deviations are also shown.

The numeric information is also calculated to facilitate the understanding of the plot. Both numeric and graphic data can be exported by mean of the buttons located at the right side of the window:



Export Graph: To export the plot to a BMP file.



Export Data: To export the statistical results to an Excel® file.

15. Data Meaning

15.1. Subject information

15.1.1. Subjects properties

15.1.1.1.Subject Name

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the subject used in the experiment.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.2.Subject Group

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the group of the subject used in the experiment.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.3.Subject Gender

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Gender of the subject used in the experiment.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.4.Subject Age

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Age of the subject used in the experiment.
Units	User-defined units
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.5.Subject Genotype

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Genotype of the subject used in the experiment.
Specific scientific meaning	The genotype is the genetic makeup or background of the subject used in the experiment. Example: Wild-type, DAT-KO etc.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.6.Subject Phenotype

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Phenotype of the subject used in the experiment.
Specific scientific meaning	The phenotype is the observable characteristics or traits of the subject, resulting from the expression of its genotype in a given environment.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.7.Subject Treatment

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Treatment given the subject used in experiment (if any).
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.8.Subject Dose

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Dose of the treatment given by the subject used in the experiment (if any).
Units	User-defined unit
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.1.1.9.Subject Extra-Field

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Additional information/comment about the subject used in the experiment.
Origin of the data	Experimentation Assistant/Subject Data base
Created/Defined by	User

15.2. Session information

15.2.1. Experiment data

15.2.1.1. Experimenter

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the Experimenter who registered the analyzed trial
Origin of the data	View/Experiment Info panel
Created/Defined by	User

15.2.1.2. Exp. File Date

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Data Subsection	Experiment Info
Description	Date of creation of the SMART experimental file containing the analyzed trial (synchronized with the date of the computer).
Units	The format of the date depends on the regional configuration of the computer used.
Origin of the data	View/Experiment Info panel
Created/Defined by	SMART (automated field)

15.2.1.3. Exp. File Time

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Time of creation of the SMART experimental file containing the analyzed trial (synchronized with the time of the computer).
Units	The format of the time depends on the regional configuration of the computer used. Commonly expressed in HH:MM:SS
Origin of the data	View/Experiment Info panel
Created/Defined by	SMART (automated field)

15.2.1.4. Exp. File Date Last Modif.

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Date of the last modification of the SMART experimental file containing the analyzed trial (synchronized with the date of the computer).
Units	The format of the date depends of the regional configuration of the computer used.
Origin of the data	Saving process
Created/Defined by	SMART (automated field)

15.2.1.5. Exp. File Time Last Modif.

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Time of the last modification of the SMART experimental file containing the analyzed trial (synchronized with the time of the computer).
Units	The format of the time depends of the regional configuration of the computer used. Commonly expressed in HH:MM:SS
Origin of the data	Saving process
Created/Defined by	SMART (automated field)

15.2.1.6. Exp. Code

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Code provided to the experiment
Origin of the data	View/Experiment Info panel
Created/Defined by	User

15.2.1.7. Exp. Comments

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Additional information/comment about the subject
Origin of the data	View/Experiment Info panel
Created/Defined by	User

15.2.1.8.Exp. Protocol name

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the SMART module used for creating experimental file containing the analyzed trial.
Origin of the data	Starting assistant choice or File/new choice
Created/Defined by	User

15.2.1.9.Exp. Exp. File name

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the experimental file given by the User when the file has been saved for the first time.
Origin of the data	Saving process
Created/Defined by	User

15.2.2. Trial data

15.2.2.1. Trial Phase

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the experimental phase in which the Trial has been registered.
Origin of the data	Experimentation Assistant/Scheduler
Created/Defined by	User

15.2.2.2.Trial Session

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name of the experimental session in which the Trial has been registered.
Origin of the data	Experimentation Assistant/Scheduler
Created/Defined by	User

15.2.2.3. Trial name

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name/number of the analyzed Trial.
Origin of the data	Experimentation Assistant/Scheduler
Created/Defined by	SMART (Automated parameter)

15.2.2.4. Trial comments

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Comments associated to the trial and entered during the data acquisition process.
Origin of the data	Experimentation Assistant/Scheduler
Created/Defined by	SMART (Automated parameter)

15.2.2.5. Trial Arena

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Name/number of the Zone definition Arena in which the trial has been registered.
Origin of the data	Experimentation Assistant/Arenas, Zones Definition
Created/Defined by	User

15.2.2.6. Trial Date

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Date of registration of the analyzed trial (synchronized with the date of the computer).
Units	The format of the date depends of the regional configuration of the computer used.
Origin of the data	Saving process (computer date)
Created/Defined by	SMART (automated parameter)

15.2.2.7. Trial Time

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Time of registration of the analyzed trial (synchronized with the time of the computer).
Units	The format of the time depends of the regional configuration of the computer used. Commonly expressed as HH:MM:SS.
Origin of the data	Saving process (computer time)
Created/Defined by	SMART (automated parameter)

15.2.2.8. Trial Duration

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Total duration of the registered trial.
Units	HH:MM:SS,oo.
Origin of the data	Trial registration process
Created/Defined by	SMART (automated parameter)

15.2.2.9. Trial Sampling Time (Seconds)

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Sampling time, meaning the interval of time between two consecutive registered data samples in analyzed trial. The sampling time depends of the image source used during the experiment.
Units	Seconds.
Specific scientific meaning	This information reflects the number of trajectory sample points registered per each unit of time.
Origin of the data	Experimentation Assistant/Image source/Cameras considerations
Created/Defined by	SMART (automated parameter)

15.2.2.10. Trial Sample Number

SMART modules & Extensions	All SMART modules & Extensions
Reports	All reports
Description	Total number of data samples registered during the Trial. The sample number depends of the sampling time and of the duration of the trial
Formula	Sample number = Trial duration / Sampling Time.
Units	Seconds.
Specific scientific meaning	This information reflects the number of trajectory sample points registered per each unit of time.
Created/Defined by	SMART (automated parameter)

15.3. Acquired data

15.3.1. Summary report

15.3.1.1. Tracking Standard

Entries in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Number of subject entries into the zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The zone in which the subject begins the trial is not counted as an entry.
Units	Number of entries.
Specific scientific meaning	This parameter can be used for the interpretation of a data in some experimental paradigms. Here some examples: Evaluation of animal locomotor activity. Evaluation of animal preference respect to a given zone in a maze used as anxiety, memory, rewarding, exploration (etc.) index.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Latency 1^{st} Entrance to Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time elapsed until the first entry of the subject into the zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The zone in which the subject begins the trial is not counted as an entry.
Units	Seconds
Specific scientific meaning	This parameter can be used for the interpretation of a data in some experimental paradigms. Here some examples: Evaluation of animal anxiety state.

	Evaluation of animal response time (arm choice…)
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest

Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time spent by the subject in the zones of the zone definition associated to the analyzed trial.
Units	Seconds
Specific scientific meaning	This parameter is used for the interpretation of a data in wide range of experimental paradigms. Here some examples: Evaluation of animal position or preference respect to a given zone in a maze used as anxiety, memory, rewarding, exploration (etc.) index.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Time in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Percentage of time spent by the subject in the zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Time in Zone = (Time in Zone x100)/Total Time
Units	%

Specific scientific meaning	This parameter is used for the interpretation of a data in wide range of experimental paradigms such as: Evaluation of animal position or preference respect to a given zone in a maze used as anxiety, memory, rewarding, exploration (etc.) index.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Total Distance

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Total distance covered by the subject during the analyzed trial.
Units	Calibration units (cm or inches)
Specific scientific meaning	Quantitative evaluation of animal locomotor activity.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Distance in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Distance covered by the subject in the zones of the zone definition associated to the analyzed trial.
Units	Calibration units (cm or inches)
Specific scientific meaning	Quantitative evaluation of animal locomotor activity.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Distance in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Percentage of distance covered by the subject in the zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Distance in Zone = (Time in Zone x100)/Total Distance
Units	%
Specific scientific meaning	Quantitative evaluation of animal locomotor activity.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Resting Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time spent in Resting state (immobile) and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in Resting state when its speed is < to the user-defined Resting/Slow speed threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Slow Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time spent in Slow speed and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in Slow state when its speed is ≥ to the user-defined Resting/Slow speed threshold setting and < to the user-defined Slow/Fast speed threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used)

	Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Fast Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time spent in Fast speed and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in Fast state when its speed is ≥ to the user-defined Slow/Fast speed threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Resting Time in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Percentage of time spent in Resting state (immobile) and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Time Resting in Zone = (Time Resting in Zone x 100)/(Time Resting + Time Slow + Time Fast)
Units	%

Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Slow Time in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Percentage of time spent in Slow speed state and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Time Slow in Zone = (Time Slow in Zone x 100)/(Time Resting + Time Slow + Time Fast)
Units	%
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Fast Time in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI

Description	Percentage of time spent in Fast speed state and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Time Fast in Zone = (Time Fast in Zone x 100)/(Time Resting + Time Slow + Time Fast)
Units	%
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Mean Speed in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Mean speed of subject calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	Mean Speed in Zone = Distance covered in Zone / Time in Zone
Units	Units of calibration (cm or inches)/seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest

	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Mean Speed w/o Resting in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Mean speed of subject displacement (excluding periods in which the subject is immobile) calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	Mean Speed w/o Resting in Zone = (Distance covered in Zone – Distance covered when the subject is Resting state in Zone) / (Time in Zone – Time spent in Resting state)
Units	Units of calibration (cm or inches)/seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Speed threshold Resting/Slow Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

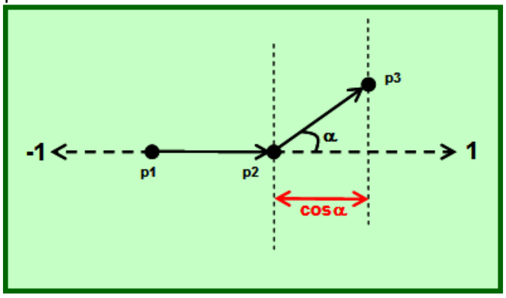
Max Speed in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Max speed reached by the subject and calculated for each zones of the zone definition associated to the analyzed trial.
Units	Units of calibration (cm or inches)/seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Min Speed in Zone

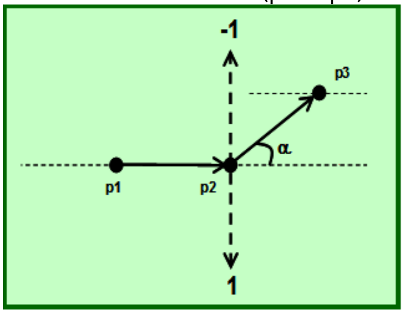
SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Minimal speed reached by the subject and calculated for each zones of the zone definition associated to the analyzed trial.
Units	Units of calibration (cm or inches)/seconds
Specific scientific meaning	Qualitative evaluation of animal locomotor activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Speed smoothing time Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Parallel Index in Zone

SMART modules & Extensions	CS, OF
Description	The parallel index indicates how parallel is a given direction of the animal single movement in comparison to the direction of its previous single movement.
Formula & Special cases	The angle of the path between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2) is considered for calculation the parallel index. If this angle is < 20°, the value of the cosine of this angle is considered for this sample in the parallel index calculation.  If this angle is < 90°, the value 0 is considered for this sample in the parallel index calculation. If this angle is > 90°, the value -1 is considered for this sample in the parallel index calculation. The samples corresponding to track displacement < 0.5 cm are not taken into consideration in the calculation. The parallel index is the average of all the value of the considered samples. The possible values of parallel index are then between -1 and 1. The more the index is closed to 1, the more the animal's displacement follows a straight line. The more the index is -1, the more the animal experiences changes of direction in its displacements.
Specific scientific meaning	The parallel index has been proposed to reflect the overall tendency to turn and the angular magnitude of turns. The parallel index is not directly dependent on the distance covered by the animal, and seems to significantly reflect subtle changes in the pattern of locomotor activity that is characteristic of the exploration of an unfamiliar environment compared to the locomotor movement in frequently visited

	areas. It is postulated that the parallel index decreases with the familiarity of the area being explored. The parallel index can also be used for characterizing the effect of a drug on the pattern of animal locomotor displacements (as an example, its value is increased by amphetamine).
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Turning Tendency in Zone

SMART modules & Extensions	CS, OF
Description	The turning tendency gives an indication of the pattern of rotation of the animal trajectory.
Formula & Special cases	The turning tendency is calculated for each sample of time taking into account the angle between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2).  A positive value of 1 is given to each sample which angle corresponds to a rotation to the right direction. A negative value of -1 is given to each sample which angle corresponds to a rotation to the right direction.

	The samples corresponding to track displacement < 0.5 cm are not taken into consideration in the calculation. The turning tendency index is the average of all the value of the considered samples.
Specific scientific meaning	The turning tendency calculation is of particular interest in any experiment in which the animal is expected to have a turning tendency, as an example, in studies on animal models of Parkinson disease with unilateral lesions in the dopaminergic nigrostriatal system. In that case, the amount of rotation is correlated with the volume of the lesion.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Sample Number in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Total number of data samples registered in each zone during the Trial. The sample number depends of the sampling time and of the time spent in the zone.
Formula & Special cases	Sample number = Time spent in the zone / Sampling Time.
Origin of the data	Image source
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Zone Transition Number

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Total number of zone change made by the subject in the analyzed trial.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

15.3.1.2.Tracking Water-Maze (WM)

Latency to Target (Seconds)

SMART modules & Extensions	CS, WM
Description	Time elapsed until the subject reaches the Target zone (platform).
Formula & Special cases	In SMARTCS module, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM module, the platform zone is already set as the Target zone and this settings cannot be modified) When the "After x secs visiting target zone" condition of STOP is used for analysis, the time spent in the platform is not considered in the calculation. If several zones are defined as "Target", the latency is the time until the subject is detected in the first of those zones (and fulfilling the timing STOP condition). When the Target zone is not reached by the subject during the trial, the value given is the time elapsed until the trial ends.
Units	Seconds

Specific scientific meaning	The evolution of the value of this parameter is used as an index of spatial memory in the Morris water maze test.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Timings STOP conditions Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

Latency 1st Entrance to Target (Seconds)

SMART modules & Extensions	CS, WM
Description	Time elapsed until the subject enters into the Target zone for the first time.
Formula & Special cases	In SMARTCS, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM, the platform zone is already set as the Target zone and this settings cannot be modified) If several zones are defined as "Target", the latency is the time until the subject is detected in the first of those zones. When the Target zone is not reached by the subject during the trial, the system returns an empty field.
Units	Seconds
Specific scientific meaning	This calculation helps in the interpretation relative to the Latency to Target calculation in the Morris water maze test.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

Target Crossings

SMART modules & Extensions	CS, WM

Description	Number time the subject has crossed the target zone (platform) during the trial.
Formula & Special cases	In SMARTCS, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM, the platform zone is already set as the Target zone and this settings cannot be modified) If several zones are defined as "Target", the number crossing will be the total number of target crossings of all the zones together.
Specific scientific meaning	The former platform crossings made during the probe phase of the Morris water maze test can be used as an index of memory.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

Distance to Target

SMART modules & Extensions	CS, WM
Description	Distance covered by the subject until reaching the Target zone.
Formula & Special cases	In SMARTCS, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM, the platform zone is already set as the Target zone and this settings cannot be modified) When the "After x secs visiting target zone" condition of STOP is used for analysis, the distance covered in the platform is not considered in the calculation. If several zones are defined as "Target", the value of this calculation is the distance covered until the subject is detected in the first of those zones (and fulfilling the timing STOP condition).

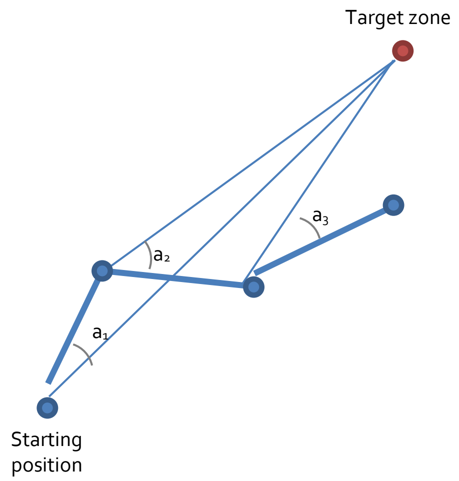
	When the Target zone is not reached by the subject during the trial, the value given is the distance covered until the trial ends.
Units	Unit of calibration (cm or inches)
Specific scientific meaning	The evolution of the value of this parameter is used as an index of spatial memory in the Morris water maze test.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Timings STOP conditions Track Filters Tracking point Criterion (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

Mean Distance to Target

SMART modules & Extensions	CS, WM
Description	The mean distance to target calculates the shortest distance between the tracked point of the subject and the target zone and gives the average of this value by unit of time.
Formula & Special cases	In SMARTCS, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM, the platform zone is already set as the Target zone and this settings cannot be modified) When the "After x secs visiting target zone" condition of STOP is used for analysis, the distance covered in the platform is not considered in the calculation. If several zones are defined as "Target", the value of this calculation is the distance covered until the subject is detected in the first of those zones (and fulfilling the timing STOP condition).
Units	Unit of calibration (cm or inches)
Specific scientific meaning	In the Morris water maze test, this parameter gives an index of how much a subject has been close to the platform during the trial.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Timings STOP conditions

	Track Filters Tracking point Criterion (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

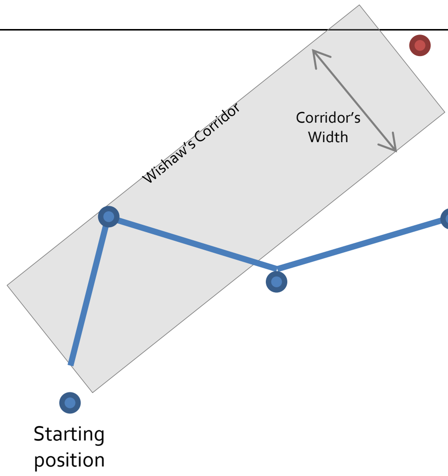
Mean Directionality to Target

SMART modules & Extensions	CS, WM
Description	The mean directionality is the numerical average of all absolute values of directionality expressed in degrees defined as a measure of the extent to which the path heads directly towards the Target zone (platform) as against veering in different directions.
Formula & Special cases	In SMART-CS, a zone has to be defined as Target in the zone definition associated to the analyzed trial ((Zone definition, Zones and Associations management). In SMART-WM, the platform zone is already set as the Target zone and this settings cannot be modified) Formula = ArcTan(Avg(Sin(a)) / Avg(Cos(a))). Where ArcTan = Tangential Arc (inverse of tangent) Avg = Average Sin = Sine Cos = Cosine a =angle between the vector of the current direction of the subject path respect to the vector representing the direct path heading to center of the target zone.  The portions of the track with displacement < 0.5 cm are not taken into consideration in the calculation.
Units	Unit of calibration (cm or inches)

Specific scientific meaning	When MDT is close to 0º, the subject's trajectory tends head directly to the target zone to take a direction opposite to the target zone direction. When MDT is close to 90º, the subject's trajectory tends to take an "east" direction perpendicular to the target zone direction. When MDT is close to 180º, the subject's trajectory tends to take a direction opposite to the target zone direction. When MDT is close to 270º, the subject's trajectory tends to take a "west" direction perpendicular to the target zone direction.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Timings STOP conditions Track Filters Tracking point Criterion (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated only for the Target zone

<u>Whishaw's Error</u>

SMART modules & Extensions	CS
Description	The Whishaw's error is the percentage time the path of the subject is outside the beeline corridor defined by the user between the starting point of the track and the center of mass of the Target zone (platform).
Formula & Special cases	In SMARTCS, a zone has to be defined as Target in the zone definition associated to the analyzed trial (Zone definition, Zones and Associations management). In SMARTWM, the platform zone is already set as the Target zone and this settings cannot be modified) The Whishaw's error corridor Width is defined by the user when selecting the calculation to be included in the report (in the section "Settings associated to the selected calculation") Target zone

	 Whishaw's Error = ((Tt – TC) x 100)/Tt Tt = Total duration of the trial TC = Time spent in the Whishaw's corridor If the entire subject's track is contained in the Whishaw's corridor the value of the Whishaw's error is 0%. If the entire subject's track is out of the Whishaw's corridor the value of the Whishaw's error is 100%.
Units	The unit considered for both the corridor width and Whishaw's error calculation is the unit of calibration used during the acquisition of each trial (cm or inches)
Specific scientific meaning	This parameter has been defined as a measure of average directionality to the target zone.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (a zone needs to be defined as "Target" zone). Corridor Width Timings STOP conditions Track Filters Tracking point Criterion (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

15.3.1.3. Tracking T/Y-Maze (TY)

1st Arm Choice

SMART modules & Extensions	CS, TY
Description	Name of the first arm chosen/visited by the subject.
Formula & Special cases	In the SMARTCS module, the zones corresponding to the 3 arms of the T/Y maze and a Middle zone have to be selected in the zone definition associated to the trials to analyze (section "Settings for Zone Dependent Calculations/Triplet Settings) In the SMARTTY experimental module, the zones defined as Arm zones and Middle zone are already preconfigured and cannot be modified by the user.
Specific scientific meaning	This calculation is used in T-maze procedures (two-trial task) as an index of spatial working memory.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Triplet settings panel in SMARTCS module). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

1st Choice Latency (Seconds)

SMART modules & Extensions	CS, TY
Description	Time elapsed until the subject makes its first arm choice.
Formula & Special cases	In the SMARTCS module, the zones corresponding to the 3 arms of the T/Y maze and a Middle zone have to be selected in the zone definition associated to the trials to analyze (section "Settings for Zone Dependent Calculations/Triplet Settings) In the SMARTTY experimental module, the zones defined as Arm zones and Middle zone are already preconfigured and cannot be modified by the user.
Units	Seconds
Specific scientific meaning	This calculation is used in T-maze procedures (two-trial task) as an index of indecision.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Triplet settings panel in SMARTCS module).

	Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

Alternation Triplet

SMART modules & Extensions	CS, TY
Description	Number of 3 consecutive entries in different arms.
Formula & Special cases	In the SMARTCS module, the zones corresponding to the 3 arms of the T/Y maze and a Middle zone have to be selected in the zone definition associated to the trials to analyze (section "Settings for Zone Dependent Calculations/Triplet Settings) In the SMARTTY experimental module, the zones defined as Arm zones and Middle zone are already preconfigured and cannot be modified by the user.
Specific scientific meaning	This calculation is used in Y-maze procedures (continuous spontaneous alternation task) as an index of spatial working memory.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Alternation Triplet settings panel in SMARTCS module). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

Alternation Triplet (%)

SMART modules & Extensions	CS, TY
Description	Percentage number of alternations triplet respect to the maximal number of possible alternations.
Formula & Special cases	Alternation Triplet % = (Number of alternation triplet x 100)/(Max Alternation Triplet) See details of Alternation Triplet calculation in the corresponding section.
Units	%
Specific scientific meaning	This calculation is used in Y-maze procedures (continuous spontaneous alternation task) as an index of spatial working memory.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Alternation Triplet settings panel in SMARTCS module). Track Filters

	Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	NA

<u>Max Alternation Triplet</u>

SMART modules & Extensions	CS, TY
Description	Maximal number of possible alternations.
Formula & Special cases	Max Alternation Triplet = Total Arm Entries – 2 See details about the calculation of Total Arm Entries in the corresponding section.
Specific scientific meaning	This calculation is mainly used in T/Y maze procedures as an index of general animal locomotor activity.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Alternation Triplet settings panel in SMARTCS module). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

<u>Total Arm Entries</u>

SMART modules & Extensions	CS, TY
Description	Total number of entries into each arm.
Formula & Special cases	In the SMARTCS module, the zones corresponding to the 3 arms of the T/Y maze and a Middle zone have to be selected in the zone definition associated to the trials to analyze (section "Settings for Zone Dependent Calculations/Triplet Settings) In the SMARTTY experimental module, the zones defined as Arm zones and Middle zone are already preconfigured and cannot be modified by the user.
Specific scientific meaning	This calculation is mainly used in T/Y maze procedures as an index of general animal locomotor activity.
Created/Defined by	SMART (automated calculation)
Related settings	Zones Definition (the arms have to be defined in the Alternation Triplet settings panel in SMARTCS module). Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

15.3.1.4.Tracking Conditioned Place Platform (CPP)

Relative Time in Zone (Seconds)

SMART modules & Extensions	CS, CPP
Description	The relative time in a zone can be calculated in a zone definition containing more than 1 zone. In that case, the time spent in one user-defined zone is distributed to all the other zones of the zone definition associated to the analyzed trial, in a way that maintains constant the total duration of the trial. The recalculated time spent into the "receiving zone" is then named "relative time".
Formula & Special cases	In the SMARTCS module, a zone which time will be distributed to all the other zones should be selected in the zone definition associated to the trials to analyze (section "Settings for Zone Dependent Calculations/Relative Time Settings) Example of a zone definition with 3 zones: A, B, C. The C zone is the "distributed" one, so its time will be distributed to all the other zones of the zone definition. TrA = (TA x (TA +TB+TC))/(TA + TB). and TrB = (TB x (TA +TB+TC))/(TA + TB). Where, TrA = Relative Time in Zone A TA = time spent in Zone A TB = time spent in Zone B TC = time spent in Zone C This calculation is independent of the selection of "zone of Interest". In the SMARTCPP experimental module, the zone definition is already predefined: C zone refers to the corridor zone (distributed zone) and A/B zones refer to the Drug/Placebo associated compartments. The Corridor zone is then distributed to the 2 compartments.
Units	Seconds
Specific scientific meaning	This calculation is commonly used in the conditioned place preference or aversion experimental paradigm in which a box with 3 zones is used (2 compartments and 1 corridor). The relative time into the compartments is used to proportionally distribute the time spent into the corridor into the value of the time spent into the 2 other

	compartments of the box. This operation normalizes the data between each subject and allows comparing the % of time spent in each of the compartments associated to the Drug or Placebo treatments.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition (a "Distributed" zone has to be selected) Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings
Distribution mode	Calculated by taking into account all the zones included in the zone definition file but the data is shown only for the zones defined by the user as zone of interest.

Relative Time in Zone (%)

SMART modules & Extensions	CS, CPP
Description	% expression of the Relative Time in Zone (for more details see definition of this calculation in this chapter) respect to the total time spent into the zones considered in the calculation.
Formula & Special cases	Relative time in zone (n) % = (Relative time in zone (n) x 100)/Total time. n = name of the zone. See details of the calculation of the Relative time in zone in the related section.
Units	%
Specific scientific meaning	This calculation is commonly used in the conditioned place preference or aversion experimental paradigm in which a box with 3 zones is used (2 compartments and 1 corridor). The relative time into the compartments is used to proportionally distribute the time spent into the corridor into the value of the time spent into the 2 other compartments of the box. This operation normalizes the data between each subject and allows comparing the % of time spent in each of the compartments associated to the Drug or Placebo treatments.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition (a "Distributed" zone has to be selected) Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings

Distribution mode	Calculated by taking into account all the zones included in the zone definition file but the data is shown only for the zones defined by the user as zone of interest.

15.3.1.5. Tracking Social Interaction (SI)

Contact Number Total -Trial

SMART modules & Extensions	SI
Description	Total number of contacts detected between the subjects of the trial.
Specific scientific meaning	The measurement of contacts is usually considered as a social behavior event.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social interaction settings START/END Time interval settings

Contact Number Total - Subject

SMART modules & Extensions	SI
Description	Total number of contacts detected between the current and the other subjects of the trial.
Specific scientific meaning	The measurement of contacts is usually considered as a social behavior event.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social interaction settings START/END Time interval settings

15.3.1.6. Tracking TriWise (TW)

Rearing Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of rearing events detected in the analyzed trial using the TriWise extension.
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Rearing Number in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of rearing events detected using the TriWise extension and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The number of rearing events detected in each zone is considered as the number of rearing event that has been initiated in this zone.
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Rearing Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time spent doing rearing in the analyzed trial.
Units	Seconds
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Rearing Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time spent doing rearing calculated for each zones of the zone definition associated to the analyzed trial.
Units	Seconds
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

<u>Rearing Mean Duration (Seconds)</u>

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Mean duration of the rearing events detected in the analyzed trial with the TriWise extension.
Formula & Special cases	Rearing Mean Duration = Rearing Duration Total / Rearing Number Total
Units	Seconds
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

<u>Rearing Latency (Seconds)</u>

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time elapsed until the detection of the first rearing event with the TriWise extension in the analyzed trial.
Units	Seconds
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Rearing Rate (ev./min)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Number of rearing event detected in the analyzed by unit of time.
Units	Event/minute
Specific scientific meaning	The measurement of rearing behavior is commonly used as an index of animal exploration behavior.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of counterclockwise rotation events detected in the analyzed trial using the TriWise extension.
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in

	animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

<u>CCW Rotation Number in Zone</u>

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of counterclockwise rotation events detected using the TriWise extension and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The number of counterclockwise rotation events detected in each zone is considered as the number of counterclockwise rotation event that has been initiated in this zone.
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

CCW Rotation Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total time spent doing counterclockwise rotations in the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time spent doing counterclockwise rotations calculated for each zones of the zone definition associated to the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used)

	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Mean Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Mean duration of the counterclockwise rotations events detected in the analyzed trial with the TriWise extension.
Formula & Special cases	CCW Rotation Mean Duration = CCW Rotation Duration Total / CCW Rotation Number Total
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Latency (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time elapsed until the detection of the first counterclockwise Rotation event with the TriWise extension in the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in

	a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Rate (ev./min)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Number of counterclockwise rotations event detected in the analyzed by unit of time.
Units	Event/minute
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CW Rotation Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of clockwise rotation events detected in the analyzed trial using the TriWise extension.
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the

	striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

CW Rotation Number in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of clockwise rotation events detected using the TriWise extension and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The number of clockwise rotation events detected in each zone is considered as the number of clockwise rotation event that has been initiated in this zone.
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

CW Rotation Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total time spent doing counterclockwise rotations in the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

<u>CW Rotation Duration in Zone (Seconds)</u>

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time spent doing clockwise rotations calculated for each zones of the zone definition associated to the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings

Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CW Rotation Mean Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Mean duration of theclockwise rotations events detected in the analyzed trial with the TriWise extension.
Formula & Special cases	CW Rotation Mean Duration = CW Rotation Duration Total / CW Rotation Number Total
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

CCW Rotation Latency (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time elapsed until the detection of the first clockwise Rotation event with the TriWise extension in the analyzed trial.
Units	Seconds
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.

Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

CCW Rotation Rate (ev./min)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Number of clockwise rotations event detected in the analyzed by unit of time.
Units	Event/minute
Specific scientific meaning	For the evaluation of the animal global motor pattern. In a more specific manner, the measurement of rotation behavior is commonly used in animal model of Parkinson with a lateral lesion of the dopaminergic innervation of the striatum. In that case, the extent of rotation in a given direction is correlated with the extent of the lesion performed.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Stretching Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of stretching events (or animal body elongations) detected in the analyzed trial using the TriWise extension.
Specific scientific meaning	NA
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used)

	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Stretching Number in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total number of stretching events (or animal body elongations) detected using the TriWise extension and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The number of stretching events detected in each zone is considered as the number of stretching event that has been initiated in this zone.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Stretching Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Total time spent doing stretching events (or animal body elongations) in the analyzed trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Stretching Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time spent doing stretching events (or animal body elongations) calculated for each zones of the zone definition associated to the analyzed trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Stretching Mean Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Mean duration of the stretching events (or animal body elongations) detected in the analyzed trial with the TriWise extension.
Formula & Special cases	Stretching Mean Duration = Stretching Duration Total / Stretching Number Total
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Stretching Latency (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Time elapsed until the detection of the first stretching event (or animal body elongations)

	with the TriWise extension in the analyzed trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Stretching Rate (ev./min)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Description	Number of stretching events (or animal body elongations) detected in the analyzed by unit of time.
Units	Event/minute
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching Threshold Track Filters Tracking Point Selection (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

15.3.1.7.Global Activity

Global Activity Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Total global activity registered in the analyzed trial.
Formula & Special cases	The value of global activity is the sum of the differences between each 2 consecutive frames of the image source processed during the acquisition of the data and expressed in surface of calibration units. This accumulated difference is then divided by two as a punctual movement of the animal generates a change in both the new place and in the space left in the image.
Units	Surface of calibration unit (cm^2 or $inches^2$)

Specific scientific meaning	Quantitative evaluation of animal global activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Activity Smoothing START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Global Activity in Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Global activity registered and calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The value of global activity is the sum of the differences between each 2 consecutive frames of the image source processed during the acquisition of the data and expressed in surface of calibration units. This accumulated difference is then divided by two as a punctual movement of the animal generates a change in both the new place and in the space left in the image.
Units	Surface of calibration unit (cm^2 or $inches^2$)
Specific scientific meaning	Quantitative evaluation of animal global activity and movement pattern.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Activity Smoothing START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Global Activity in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of global activity registered in the zone respect to the total global activity registered in the analyzed trial.
Formula & Special cases	% GA in Zone = (GA in Zone x 100)/GA Total
Units	%
Specific scientific meaning	Quantitative evaluation of animal global activity and movement pattern.

Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Activity Smoothing START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Immobility Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in Immobile state in the analyzed trial.
Formula & Special cases	The subject is considered in Immobile state when its global activity is < to the user-defined Low Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes. Index for antidepressive effect of therapeutic drugs in the Forced-swimming (Porsolt) and Tail-suspension tests. Index related to emotional memory in the Fear conditioning test. Etc.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Immobility Duration Total (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in Immobile state in the analyzed trial respect to the total duration of the trial.
Formula & Special cases	% Immobility Duration Total = (Immobility Duration Total x 100)/ (Immobility Duration + Low Act. Duration + High Act. Duration).
Units	%

Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes. Index for antidepressive effect of therapeutic drugs in the Forced-swimming (Porsolt) and Tail-suspension tests. Index related to emotional memory in the Fear conditioning test. Etc.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Immobility Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in Immobile state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in Immobile state when its global activity is ≥ to the user-defined Low Activity threshold setting and < to the user-defined High Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes. Index for antidepressive effect of therapeutic drugs in the Forced-swimming (Porsolt) and Tail-suspension tests. Index related to emotional memory in the Fear conditioning test. Etc.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Immobility Duration in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in Immobile state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Immobile Duration in Zone = (Immobile Duration in Zone x 100)/ (total Immobility Duration + total Low Act. Duration + total High Act. Duration).
Units	%
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes. Index for antidepressive effect of therapeutic drugs in the Forced-swimming (Porsolt) and Tail-suspension tests.

	Index related to emotional memory in the Fear conditioning test. Etc.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Low Act. Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in low activity state in the analyzed trial.
Formula & Special cases	The subject is considered in low activity state when its global activity is ≥ to the user-defined Low Activity threshold setting and < to the user-defined High Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low and High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Low Act. Duration Total (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in low activity state in the analyzed trial respect to the total duration of the trial.
Formula & Special cases	% Low Act. Duration Total = (Low Act. Duration Total x 100)/ (Immobility Duration + Low Act. Duration + High Act. Duration).
Units	%

Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low and High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Low Act. Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in low activity state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in low activity state when its global activity is ≥ to the user-defined Low Activity threshold setting and < to the user-defined High Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing Low and High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Low Act. Duration in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in low activity state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% Low Act. Duration in Zone = (Immobile Duration in Zone x 100)/ (Total Immobility Duration + Total Low Act. Duration + Total High Act. Duration).
Units	%
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing Low and High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

High Act. Duration Total (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in high activity state in the analyzed trial.
Formula & Special cases	The subject is considered in high activity state when its global activity is ≥ to the user-defined High Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

High Act. Duration Total (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in high activity state in the analyzed trial respect to the total duration of the trial.
Formula & Special cases	% High Act. Duration Total = (High Act. Duration Total x 100)/(Immobility Duration + Low Act. Duration + High Act. Duration).
Units	%
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

High Act. Duration in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Time spent in high activity state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	The subject is considered in high activity state when its global activity is ≥ to the user-defined High Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

High Act. Duration in Zone (%)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Percentage of time spent in high activity state calculated for each zones of the zone definition associated to the analyzed trial.
Formula & Special cases	% High Act. Duration in Zone = (Immobile Duration in Zone x 100)/ (Total Immobility Duration + Total Low Act. Duration + Total High Act. Duration).
Units	%
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Immobility Filter Activity Smoothing High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Immobility Number total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Number of registered Immobile episodes in the analyzed trial.
Formula & Special cases	The subject is considered in Immobile state when its global activity is < to the user-defined Low Activity threshold setting.
Units	Seconds
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes. Index for antidepressive effect of therapeutic drugs in the Forced-swimming (Porsolt) and Tail-suspension tests. Index related to emotional memory in the Fear conditioning test. Etc.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings

	EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Low Act. Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Number of registered low activity episodes in the analyzed trial.
Formula & Special cases	The subject is considered in low activity state when its global activity is ≥ to the user-defined Low Activity threshold setting and < to the user-defined High Activity threshold setting.
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low and High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

High Act. Number Total

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA Extension
Description	Number of registered high activity episodes in the analyzed trial.
Formula & Special cases	The subject is considered in high activity state when its global activity is ≥ to the user-defined High Activity threshold setting.
Specific scientific meaning	Qualitative evaluation of animal global activity and movement pattern in standard open-field test or in any mazes.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing High Activity threshold START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

15.3.1.8.Event scoring

Event (n) Number Total

SMART modules & Extensions	All modules
Description	Total number of event (n) manually scored by the user (using the Event Marker) during the data acquisition process of the analyzed trial.
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Event (n) Number in Zone

SMART modules & Extensions	All modules
Description	Total number of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial and calculated for each zones of the associated zone definition.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each…)

Event (n) Duration Total (Seconds)

SMART modules & Extensions	All modules
Description	Total duration of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial.

Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Event (n) Duration in Zone (Seconds)

SMART modules & Extensions	All modules
Description	Total duration of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial and calculated for each zones of the associated zone definition.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zones Definition Zone of interest Track Filters Zone Transition Criterion (only if TW extension is used) START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each zone defined by the user as zone of interest. Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Event (n) Mean Duration (Seconds)

SMART modules & Extensions	All modules
Description	Mean duration of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial.
Formula & Special cases	Event Mean Duration = Event Duration Total / Event Number Total
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings EACH/SPLIT Time interval settings

Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Event (n) Latency (Seconds)

SMART modules & Extensions	All modules
Description	Time elapsed until the detection of the first events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Event (n) Rate (ev./min)

SMART modules & Extensions	All modules
Description	Number of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial and expressed by unit of time.
Units	Event/minute
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings EACH/SPLIT Time interval settings
Distribution mode	Calculated for each subinterval of time defined by the user in the Analysis Time Interval section (Each...)

Event (n) Name

SMART modules & Extensions	All modules
Description	Name of events registered manually by the user (using the Event Marker) during the data acquisition process of the analyzed trial.
Origin of the data	View/Event Marker used using the Data Acquisition process
Created/Defined by	User-defined

15.3.2. Zone Transition list report

15.3.2.1. Transition Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Index number of the zone transition. The transition Index Number begins at 1 and increases each time the animal enters in a new zone.
Formula & Special cases	The zone in which the subject begins the trial is not counted as an entry, so nor as a transition.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Zone Transition Criterion (only for TW extension). Track Filters. START/END Time interval settings.

15.3.2.2. Transition Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Time elapsed from the beginning of the trial until the subject enters into a new zone (transition). Expressed in Seconds.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.2.3. Transition Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Time elapsed from the beginning of the trial until the subject enters into a new zone (transition). Expressed in HH:MM:SS,00.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings

15.3.2.4. Transition Current Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Name of the current zone.
Origin of the data	Experimentation Assistant/Zone Definition/Zones Assoc. Management
Created/Defined by	User-Defined
Related analysis settings	Zone Definition (user-defined zone name) Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.2.5. Transition Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Time spent in the current zone. This time is reset when the subject enters again in the same zone.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.2.6. Accumulated Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Total time spent in the current zone from the beginning of the trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.2.7.Entries Number

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Total number of time the subject entered into the current zone from the beginning of the trial.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.2.8.Distance in zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY
Description	Distance traveled by the subject in the current zone. This value is reset when the subject enters again in the same zone.
Units	Calibration units (cm or inches)
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension). Track Filters. START/END Time interval settings.

15.3.3. Association Transition list report

15.3.3.1. Transition Index Nr.

SMART modules & Extensions	CS, OF, PM, WM
Description	Index number of the zone association transitions. The transition Index Number begins at 1 and increases each time the animal enters in a new zone association.
Formula & Special cases	The zone association in which the subject begins the trial is not counted as an entry, so nor as a transition.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.2. Transition Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM
Description	Time elapsed from the beginning of the trial until the subject enters into a new zone association (transition). Expressed in Seconds
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.3. Transition Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM
Description	Time elapsed from the beginning of the trial until the subject enters into a new zone association (transition). Expressed in HH:MM:SS,00.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings

15.3.3.4. Transition Current Zone

SMART modules & Extensions	CS, OF, PM, WM

Description	Name of the current zone association.
Origin of the data	Experimentation Assistant / Zone Definition / Zones Assoc. Management
Created/Defined by	User-Defined
Related analysis settings	Zone Definition (user-defined zone name) Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.5. Transition Time in Zone (Seconds)

SMART modules & Extensions	CS, OF, PM, WM
Description	Time spent in the current zone association. This time is reset when the subject enters again in the same zone association.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.6. Accumulated Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM
Description	Total time spent in the current zone association from the beginning of the trial.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.7. Entries Number

SMART modules & Extensions	CS, OF, PM, WM
Description	Total number of times the subject entered into the current zone association from the beginning of the trial.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.3.8. Distance in zone

SMART modules & Extensions	CS, OF, PM, WM
Description	Distance traveled by the subject in the current zone association. This value is reset when the subject enters again in the same zone association.
Units	Calibration units (cm or inches)
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension). Track Filters. START/END Time interval settings.

15.3.4. Event list report

15.3.4.1. Event Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI
Description	Index number of the current event manually scored by the user. The Event Index Number begins at 1 and increases each time a new event has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	START/END Time interval settings

15.3.4.2. Event Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current event manually scored by the user.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings

15.3.4.3. Event Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current event manually scored by the user.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.4.4. Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI
Description	Name of the current event manually scored by the user.
Origin of the data	View/Event Marker/Config…
Created/Defined by	User-Defined
Related analysis settings	Event Marker configuration

15.3.4.5. Event System Time

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST , SI
Reports	Event List
Description	Date and Clock time corresponding in which the current event manually scored by the user started.
Units	The format of the time depends of the regional configuration of the computer used. Commonly expressed in mm/dd/yy HH:MM:SS
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings

15.3.4.6. Event Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST , SI
Description	Total duration of the current event manually scored by the user.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	START/END Time interval settings

15.3.4.7. Event Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST , SI
Description	Zone in which the manual scoring of the event had started.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings
Distribution mode	NA

15.3.4.8. Event Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST , SI
Description	Zone in which the manual scoring of the event had finished.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Zone Transition Criterion (only for TW extension)

	Track Filters START/END Time interval settings
Distribution mode	NA

15.3.5. Activity episode list report

15.3.5.1.Episode Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Index number of the current activity episode. The Episode Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Immobility Filter Activity Smoothing Activity Thresholds START/END Time interval settings

15.3.5.2.Episode Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Time elapsed from the beginning of the trial until the beginning of the current activity episode.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Activity Thresholds START/END Time interval settings

15.3.5.3.Episode Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Time elapsed from the beginning of the trial until the beginning of the current activity episode.
Units	HH:MM:SS,oo
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Activity Thresholds START/END Time interval settings

15.3.5.4. Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Reports	Activity Episode List
Description	Name of the current activity episode: Immobile, Low Activity or High Activity.
Units	NA
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low Activity threshold

15.3.5.5. Episode Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Total duration of the current activity episode.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Immobility Filter Activity Smoothing Low Activity threshold START/END Time interval settings

15.3.5.6. Episode Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Zone in which of the current activity episode had started.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Immobility Filter Activity Smoothing Low Activity threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.5.7. Episode Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension

Description	Zone in which the current activity episode had finished.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Immobility Filter Activity Smoothing Low Activity threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.6. TriWise rearing list report

15.3.6.1. Rearing Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Index number of the current rearing event. The Rearing Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Rearing threshold START/END Time interval settings

15.3.6.2. Rearing Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the current rearing event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing threshold START/END Time interval settings

15.3.6.3. Rearing Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the rearing event.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing threshold START/END Time interval settings

15.3.6.4. Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST Needs the TW module
Reports	Activity Episode List
Description	Name of the detected event: rearing.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing threshold START/END Time interval settings

15.3.6.5. Rearing Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Total duration of the current rearing event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rearing threshold START/END Time interval settings

15.3.6.6. Rearing Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which of the current rearing event had started.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Rearing threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.6.7. Rearing Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which the current rearing event had finished.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Rearing threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.7. TriWise rotation list report

15.3.7.1. Rotation Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Index number of the current rotation event. The rotation Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Rotation Smoothing START/END Time interval settings

15.3.7.2. Rotation Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the current rotation event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing START/END Time interval settings

15.3.7.3. Rotation Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the rotation event.
Units	HH:MM:SS,oo
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing START/END Time interval settings

15.3.7.4. Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Reports	Activity Episode List
Description	Name of the detected event: CW rotation or CCW rotation.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing START/END Time interval settings

15.3.7.5.Rotation Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Total duration of the current rotation event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Rotation Smoothing START/END Time interval settings

15.3.7.6.Rotation Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which of the current rotation event had started.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Rotation Smoothing Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.7.7.Rotation Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which the current rotation event had finished.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Rotation Smoothing Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.8. TriWise Stretching report

15.3.8.1.Stretching Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Index number of the current stretching event. The stretching Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Stretching threshold START/END Time interval settings

15.3.8.2.Stretching Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the current stretching event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching threshold START/END Time interval settings

15.3.8.3.Stretching Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Time elapsed from the beginning of the trial until the beginning of the stretching event.
Units	HH:MM:SS,oo
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching threshold START/END Time interval settings

15.3.8.4.Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Reports	Activity Episode List
Description	Name of the detected event: stretching.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching threshold START/END Time interval settings

15.3.8.5.Stretching Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Total duration of the current stretching event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Stretching threshold START/END Time interval settings

15.3.8.6.Stretching Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which of the current stretching event had started.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Stretching threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.8.7.Stretching Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the TW module
Description	Zone in which the current stretching event had finished.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Stretching threshold Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.9. Relative position list report (SMART-SI)

15.3.9.1. Rel. Pos. Index Nr.

SMART modules & Extensions	SI
Description	Index number of the current social interaction event. The Relative position Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.2. Rel. Pos. Rel. Time (Seconds)

SMART modules & Extensions	SI
Description	Time elapsed from the beginning of the trial until the beginning of the current social interaction event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.3. Rel. Pos. Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	SI
Description	Time elapsed from the beginning of the trial until the beginning of the current social interaction event.
Units	HH:MM:SS,oo
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.4. Event Name

SMART modules & Extensions	SI
Description	Name of the detected event. The components of the name are: [Relative Position] [Contact points] [Subject name A] [Subject name B]
Created/Defined by	SMART (automated calculation)

Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.5.Rel. Pos. Duration (Seconds)

SMART modules & Extensions	SI
Description	Total duration of the current relative positin event.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.6.Rel. Pos. Type

SMART modules & Extensions	SI
Description	Type of Relative Position event registered. Can be FAR, CLOSE or CONTACTING.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.7.Rel.Pos. Subject A Name

SMART modules & Extensions	SI
Description	User-defined name for the subject A.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Subject of Interest

15.3.9.8.Rel.Pos. Subject B Name

SMART modules & Extensions	SI
Description	User-defined name for the subject B.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Subject of Interest

15.3.9.9.Rel.Pos. Average Distance (cm)

SMART modules & Extensions	SI

Description	Average distance registered between the 2 subject during the event
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.10. Rel.Pos. Min Distance (cm)

SMART modules & Extensions	SI
Description	Minimum distance registered between the 2 subject during the event
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.11. Rel.Pos. Max Distance (cm)

SMART modules & Extensions	SI
Description	Maximum distance registered between the 2 subject during the event
Created/Defined by	SMART (automated calculation)
Related analysis settings	Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.12. Contact Subject A Zone START

SMART modules & Extensions	CS combined with SI
Description	Zone in which the current event had started for subject A
Comments	This data is only reliable when a reliable indentification between the subject has been made by SMART during the data acquisition system.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.13. Contact Subject A Zone END

SMART modules & Extensions	CS combined with SI

Description	Zone in which the current event had finished for subject A
Comments	This data is only reliable when a reliable indentification between the subject has been made by SMART during the data acquisition system.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.14. Contact Subject B Zone START

SMART modules & Extensions	CS combined with SI
Description	Zone in which the current event had started for subject B
Comments	This data is only reliable when a reliable indentification between the subject has been made by SMART during the data acquisition system.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Social Interaction settings Subject of Interest START/END Time interval settings

15.3.9.15. Contact Subject B Zone END

SMART modules & Extensions	CS combined with SI
Description	Zone in which the current event had finished for subject B
Comments	This data is only reliable when a reliable indentification between the subject has been made by SMART during the data acquisition system.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Social Interaction settings Subject of Interest START/END Time interval settings

15.3.10. Track Coordinates Report

15.3.10.1. Sample Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Index number of the current sample. The Sample Index Number begins at 1 and increases with each stored sample.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Subject of Interest START/END Time interval settings

15.3.10.2. Sample Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current sample.
Units	Seconds
Created/Defined by	SMART (automated parameter)
Related analysis settings	Subject of Interest START/END Time interval settings

15.3.10.3. Sample Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current sample.
Units	HH:MM:SS,oo
Created/Defined by	SMART (automated parameter)
Related analysis settings	Subject of Interest START/END Time interval settings

15.3.10.4. X Coordinate

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Calibrated X coordinate of the position of the subject in the current sample.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.5. Y Coordinate

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Calibrated Y coordinate of the position of the subject in the current sample.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.6. Distance Between Subjects

SMART modules & Extensions	SI, CS if combined with SI
Description	Calibrated distance between two subjects in the current sample.
Units	Units as configured in calibration
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each possible pair of subjects participating in the current trial.

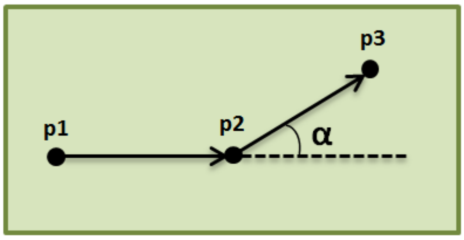
15.3.10.7. Relative Position Between Subjects

SMART modules & Extensions	SI, CS if combined with SI
Description	Relative position between two subjects in the current sample according to the Social Interaction settings. Can be FAR, CLOSE or CONTACTING.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Social Interaction Settings Subject of Interest START/END Time interval settings

15.3.10.8. Sample Zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Zone name where the subject is located in the current sample.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Zone Transition Criterion (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.9. Vector Angle (Degrees)

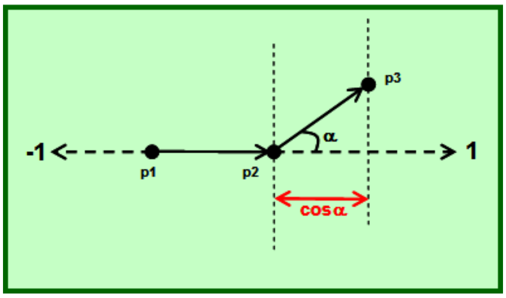
SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Angle formed by the last three consecutive valid coordinates of the subject.
Formula & Special cases	The angle of the path between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2). 
Units	Degrees
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.10. Vector Angular Speed (Degrees/Second)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI

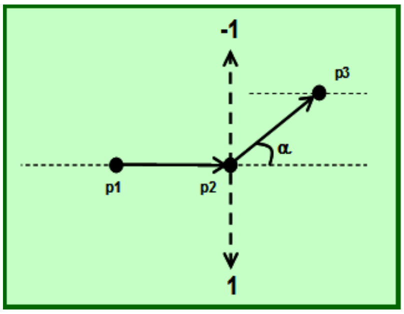
Description	Speed in degrees/second between the current vector angle and the previous vector angle.
Units	Degrees/Second
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.11. Parallel Index

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	The parallel index indicates how parallel is a given direction of the animal single movement in comparison to the direction of its previous single movement.
Formula & Special cases	The angle of the path between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2) is considered for calculation the parallel index. If this angle is < 20°, the value of the cosine of this angle is considered for this sample in the parallel index calculation.  If this angle is < 90°, the value 0 is considered for this sample in the parallel index calculation. If this angle is > 90°, the value -1 is considered for this sample in the parallel index calculation. The samples corresponding to track displacement < 0.5 cm are not taken into consideration in the calculation. The possible values of parallel index are then between -1 and 1. The more the index is closed to 1, the more the animal's displacement follows a straight line. The more the index is -

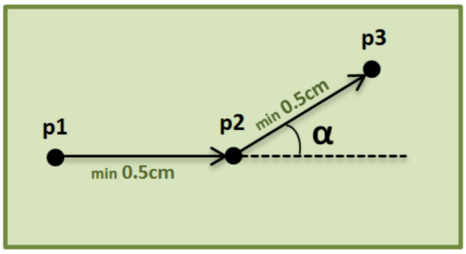
	1, the more the animal experiences changes of direction in its displacements.
Specific scientific meaning	The parallel index has been proposed to reflect the overall tendency to turn and the angular magnitude of turns. The parallel index is not directly dependent on the distance covered by the animal, and seems to significantly reflect subtle changes in the pattern of locomotor activity that is characteristic of the exploration of an unfamiliar environment compared to the locomotor movement in frequently visited areas. It is postulated that the parallel index decreases with the familiarity of the area being explored. The parallel index can also be used for characterizing the effect of a drug on the pattern of animal locomotor displacements (as an example, its value is increased by amphetamine).
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.12. Turning Tendency

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	The turning tendency gives an indication of the pattern of rotation of the animal trajectory.
Formula & Special cases	The turning tendency is calculated for each sample of time taking into account the angle between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2). 

	A positive value of 1 is given to each sample which angle corresponds to a rotation to the right direction. A negative value of -1 is given to each sample which angle corresponds to a rotation to the right direction. The samples corresponding to track displacement < 0.5 cm are not taken into consideration in the calculation.
Specific scientific meaning	The turning tendency calculation is of particular interest in any experiment in which the animal is expected to have a turning tendency, as an example, in studies on animal models of Parkinson disease with unilateral lesions in the dopaminergic nigrostriatal system. In that case, the amount of rotation is correlated with the volume of the lesion.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.13. Segment Angle (Degrees)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Angle formed by the last three consecutive valid coordinates of the subject that are at least 0.5cm and 2pixels appart.
Formula & Special cases	The angle of the path between the current direction of movement (p2 to p3, see illustration) and the previous direction of movement (p1 to p2) according to the last three consecutive valid coordinates that are at least 0.5cm and 2pixels appart. 
Units	Degrees

Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.14. Segment Length

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Length of the current segment to be considered to calculate the segment angle.
Units	Units as configured in calibration
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.15. Speed

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	The current speed of the subject. A filter that is averaged according the duration configured by the user is applied.
Units	Units of calibration (cm or inches)/seconds
Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Speed smoothing Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.10.16. Speed status

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Name of the status of the current speed of the subject: Resting, Slow, or Fast.

Created/Defined by	SMART (automated parameter)
Related analysis settings	Track Filters Speed Thresholds Tracking point selection (only if TW extension is used) Subject of Interest START/END Time interval settings
Distribution mode	Calculated for each subject participating in the current trial.

15.3.11. Speed Episode list report

15.3.11.1. Episode Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Index number of the current speed episode. The Episode Index Number begins at 1 and increases each time a new episode has been registered.
Created/Defined by	SMART (automated parameter)
Related analysis settings	Speed Smoothing Speed Thresholds START/END Time interval settings

15.3.11.2. Episode Rel. Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current speed episode.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Speed Scale Speed Smoothing Speed Thresholds START/END Time interval settings

15.3.11.3. Episode Rel. Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Time elapsed from the beginning of the trial until the beginning of the current speed episode.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated calculation)
Related analysis settings	Speed Scale Speed Smoothing Speed Thresholds START/END Time interval settings

15.3.11.4. Event Name

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Name of the current speed episode: Resting, Slow, or Fast.
Units	NA
Created/Defined by	SMART (automated calculation)
Related analysis settings	Speed Scale Speed Smoothing Speed Thresholds START/END Time interval settings

15.3.11.5. Episode Duration (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Total duration of the current speed episode.
Units	Seconds
Created/Defined by	SMART (automated calculation)
Related analysis settings	Speed Scale Speed Smoothing Speed Thresholds START/END Time interval settings

15.3.11.6. Episode Zone START

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Zone in which of the current speed episode had started.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Speed Scale Speed Smoothing Speed Thresholds Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.11.7. Episode Zone END

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Description	Zone in which the current speed episode had finished.
Formula & Special cases	The presence of the animal in a given zone is determined by the position of the tracking points registered concomitantly to the manual event scoring process, so the reliability of this data will depends of the reliability of the registered track.
Created/Defined by	SMART (automated calculation)
Related analysis settings	Zone definition Speed Scale Speed Smoothing Speed Thresholds Zone Transition Criterion (only for TW extension) Track Filters START/END Time interval settings

15.3.12. Global Activity Raw Data report

15.3.12.1. Sample Index Nr.

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Index number of the current sample. The Sample Index Number begins at 1 and increases with each stored sample.
Created/Defined by	SMART (automated parameter)
Related analysis settings	START/END Time interval settings

15.3.12.2. Sample Time (Seconds)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Time elapsed from the beginning of the trial until the beginning of the current sample.
Units	Seconds
Created/Defined by	SMART (automated parameter)
Related analysis settings	START/END Time interval settings

15.3.12.3. Sample Time (HH:MM:SS,00)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Time elapsed from the beginning of the trial until the beginning of the current sample.
Units	HH:MM:SS,00
Created/Defined by	SMART (automated parameter)
Related analysis settings	START/END Time interval settings

15.3.12.4. Current global activity in zone

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Global activity by each zone.
Units	Units of calibration (cm or inches)^2/seconds
Created/Defined by	SMART (automated parameter)
Related analysis settings	Zone of Interest Immobility Filter Activity Smoothing Activity Thresholds START/END Time interval settings
Distributed mode	Calculated for each zone defined by the user as zone of interest

15.3.12.5. Current global activitY

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs the GA Extension
Description	Accumulate of the global activity in all zones.
Units	Units of calibration (cm or inches)²/seconds
Created/Defined by	SMART (automated parameter)
Related analysis settings	Zone of Interest Immobility Filter Activity Smoothing Activity Thresholds START/END Time interval settings

15.4. Acquisition configuration

15.4.1. Calibration

15.4.1.1.ACQ. Calibration Horizontal

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Horizontal calibration used during trial registration.
Formula & Specific cases	Technically, this is the horizontal dimension of 1 pixel expressed in unit of calibration.
Origin of the data	Experimentation Assistant/Calibration
Units	Calibration unit: cm or inches
Specific scientific meaning	The calibration is needed to make SMART able to provide related data directly in cm or inches (distance, speed…).
Created/Defined by	User-defined

15.4.1.2.ACQ. Calibration Vertical

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Vertical calibration used during trial registration.
Formula & Specific cases	Technically, this is the vertical dimension of 1 pixel expressed in unit of calibration.
Origin of the data	Experimentation Assistant/Calibration
Units	Calibration unit: cm or inches
Specific scientific meaning	The calibration is needed to make SMART able to provide related data directly in cm or inches (distance, speed…).
Created/Defined by	User-defined

15.4.1.3.ACQ. Image Height (Pixels)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Height of the image received from the image source.
Units	Pixels.

Created/Defined by	SMART (automated parameter)

15.4.1.4.ACQ. Image Width (Pixels)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Width of the image received from the image source.
Units	Pixels.
Created/Defined by	SMART (automated parameter)

15.4.2. Detection settings

15.4.2.1.ACQ. Detection Brightness

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Value of the General Brightness configuration used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Brightness & Contrast
Created/Defined by	User-defined

15.4.2.2.ACQ. Detection Contrast

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Value of the General Contrast configuration used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Brightness & Contrast
Created/Defined by	User-defined

15.4.2.3.ACQ. Zone Specific BC

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Acquisition zone specific Brightness/Contrast: state of activation of the option "Use special lighting conditions for this zone" set by the User in the SMART Detection panel.
Origin of the data	Experimentation Assistant/Detection settings/Brightness & Contrast
Created/Defined by	User-defined

15.4.2.4.ACQ. Track detection mode

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Relative position Event list, Event list.
Description	Track detection mode used for data acquisition and selected in the Detection settings panel
Origin of the data	Experimentation Assistant/Detection settings/Track detection
Created/Defined by	User-defined

15.4.2.5.ACQ. Track Detection Threshold

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Value of the Track Detection Threshold configuration used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Track detection
Units	N/A (value from 0 to 255)
Created/Defined by	User-defined

15.4.2.6.ACQ. Track Detection Erosion

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Value of the Track Detection Erosion configuration used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Track detection
Units	Pixels.
Created/Defined by	User-defined

15.4.2.7.ACQ. Track Detection Anti-Vibration Filter

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Value of the option "Use anti-vibrations filter" used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Track detection
Units	Cm/sec or inch/sec.
Created/Defined by	User-defined

15.4.2.8.ACQ. Activity Detection Threshold

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, FST, SI Needs GA extension
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Value of the Activity Detection Threshold configuration used when registering the Trial.
Origin of the data	Experimentation Assistant/Detection settings/Activity detection
Units	N/A (value from 0 to 255)
Created/Defined by	User-defined

15.4.2.9.ACQ. Tracking Point Selection (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Tracking point used during the acquisition of the analyzed trial: Head, Center of mass or Tail.
Origin of the data	Experimentation Assistant/Detection settings/Track detection/TriWise Settings
Created/Defined by	User-defined

15.4.2.10. ACQ. Zone Transition Criterion (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Zone transition criterion used during the acquisition of the analyzed trial: Center of mass, Center and head, head or Whole subject.
Origin of the data	Experimentation Assistant/Detection settings/Track detection/TriWise Settings
Created/Defined by	User-defined

15.4.3. Timing settings

15.4.3.1.ACQ. Timing Mode

SMART modules & Extensions	All modules
Reports	All reports
Description	Timing Mode set by the User in the SMART Time Settings panel: free running or Pre-set time.
Origin of the data	Experimentation Assistant/Timing settings/Trial Execution
Created/Defined by	User-defined

15.4.3.2.ACQ. Timing Latency Time (HH:MM:SS,00)

SMART modules & Extensions	All modules
Reports	All reports
Description	Time latency set until data acquisition starts.
Origin of the data	Experimentation Assistant/Timing settings/Trial Execution
Units	HH:MM:SS,oo
Created/Defined by	User-defined

15.4.3.3.ACQ. Timing Acquisition Time (HH:MM:SS,00)

SMART modules & Extensions	All modules
Reports	All reports
Description	Data acquisition time (duration) set by the user.
Origin of the data	Experimentation Assistant/Timing settings/Trial Execution
Units	HH:MM:SS,oo
Created/Defined by	User-defined

15.4.3.4.ACQ. Timing Finish Mode

SMART modules & Extensions	All modules
Reports	All reports
Description	Option and configuration set by the User for stopping data acquisition.
Origin of the data	Experimentation Assistant/Timing settings/Finishing Conditions
Created/Defined by	User-defined

15.5. Analysis configuration

15.5.1. Tracking Standard

15.5.1.1.AN. Speed Smoothing

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Value of the Speed Smoothing used for analysis.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Speed Settings
Units	Seconds
Created/Defined by	User-defined

15.5.1.2.AN. Speed Threshold Resting

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Speed Slow Moving Threshold used in analysis for defining the subject resting state.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Speed Settings
Units	Cm or inches per seconds (depending on the calibration settings)
Created/Defined by	User-defined

15.5.1.3.AN. Speed Threshold Fast

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Speed Fast Moving Threshold used in analysis for defining the subject Fast moving state.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Speed Settings
Units	Cm or inches per seconds (depending on the calibration settings)
Created/Defined by	User-defined

15.5.2. Tracking TriWise (SMART-TW)

15.5.2.1.AN. Tracking Point Selection (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, Zone transition list, TriWise rearing list, TriWise rotation list, TriWise stretching list, Event list.
Description	Tracking point used in Analysis: Head, Center of mass or Tail.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/TriWise Settings
Created/Defined by	User-defined

15.5.2.2.AN. Zone transition criteria (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Zone transition criterion used in Analysis: Center of mass, Center and head, head or Whole subject.
Description	Tracking point used in Analysis: Head, Center of mass or Tail.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/TriWise Settings
Created/Defined by	User-defined

15.5.2.3.AN. Rearing Threshold (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, TriWise Rearing list.
Description	TriWise threshold used in analysis for the automated detection of rearing events.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/TriWise Settings
Created/Defined by	User-defined

15.5.2.4.AN. Rotation Smoothing (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, TriWise rotation list.
Description	TriWise smoothing time used in analysis for the automated detection of rotation events.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/TriWise Settings
Units	Seconds
Created/Defined by	User-defined

15.5.2.5.AN. Stretching Threshold (TW)

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI Needs TW extension
Reports	Summary report, TriWise stretching list.
Description	TriWise theshold used in analysis for the automated detection of stretching events.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/TriWise Settings
Created/Defined by	User-defined

15.5.3. Tracking - SI

15.5.3.1.AN. Contact Filter

SMART modules & Extensions	SMART-SI
Reports	Relative possition event report
Description	Value if the contact duration filter used for analysis. Contacts which duration is lower thatn the value filter are discarded.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Social interaction settings
Units	Absolute value
Created/Defined by	User-defined

15.5.3.2.AN. Contact Points

SMART modules & Extensions	SMART-SI combined with SMART-TW
Reports	Summary report, Relative possition event report
Description	Pair of contact points combination considered for calculations.Combinations can be Center-Center, Head-Head, Tail-Tail, Center-Head, Center – Tail, Head –Tail.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Social Interaction Settings
Created/Defined by	User-defined

15.5.3.3.AN. Contact Threshold max

SMART modules & Extensions	SMART-SI
Reports	Relative Position Event list
Description	Far threshold of minimum distance between the animals used for analysis. The Far threshold is used to determine the animal relative position between FAR and CLOSE in a social interaction test.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Social Interaction Settings
Units	Cm
Created/Defined by	User-defined

15.5.3.4.AN. Contact Threshold min

SMART modules & Extensions	SMART-SI
Reports	Relative Position Event list
Description	Close threshold of minimum distance between the animals used for analysis. The Close threshold is used to determine the animal relative position between Close and CONTACTING in a social interaction test.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Social Interaction Settings
Units	Cm
Created/Defined by	User-defined

15.5.4. Global Activity

15.5.4.1.AN. Activity Smoothing

SMART modules & Extensions	All modules Needs GA extension
Reports	Summary report, Activity episode list.
Description	Value of the Activity Smoothing used for analysis.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Activity Settings
Units	Seconds
Created/Defined by	User-defined

15.5.4.2.AN. Activity Threshold Low

SMART modules & Extensions	All modules Needs GA extension
Reports	Summary report, Activity episode list.
Description	Low Activity Threshold used in analysis for defining the subject immobility episodes.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Activity Settings
Units	cm2/s or inch2/s (depending of the calibration settings)
Created/Defined by	User-defined

15.5.4.3.AN. Activity Threshold High

SMART modules & Extensions	All modules Needs GA extension
Reports	Summary report, Activity episode list.
Description	Low Activity Threshold used in analysis for defining the subject low and high activity episodes.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Activity Settings
Units	cm2/s or inch2/s (depending of the calibration settings)
Created/Defined by	User-defined

15.5.4.4.AN. Immobility Filter

SMART modules & Extensions	All modules Needs GA extension
Reports	Summary report, Activity episode list.
Description	Value of Immobility filter used in analysis for filtering the immobility episodes by their duration.
Origin of the data	Experimentation Assistant/Analysis/Report Definition/ Report (select one)/Edit Global analysis configuration/Activity Settings
Units	Seconds
Created/Defined by	User-defined

15.5.5. Zone Definition

15.5.5.1.AN. Zone Definition name

SMART modules & Extensions	All modules
Reports	All reports
Description	Name of the Zone definition used for the analysis of the trial.
Origin of the data	Experimentation Assistant/Analysis/General Configuration/Zones Definition
Created/Defined by	User-defined

15.5.5.2.AN. Zones Number

Definition: Number of zones contained in the Zone definition used for the analysis of the trial.

SMART modules & Extensions	All modules
Reports	All reports
Description	Number of zones contained in the Zone Definition used for the analysis of the trial.
Created/Defined by	User-defined

15.5.5.3.AN. Associations Number

Definition: Number of zone associations contained in the Zone definition used for the analysis of the trial.

SMART modules & Extensions	All modules
Reports	All reports
Description	Number of associations contained in the Zone Definition used for the analysis of the trial.
Created/Defined by	User-defined

15.5.5.4.AN. Triplet Settings

SMART modules & Extensions	CS, TY
Reports	Summary report
Description	Name of the zones Center zone and the 3 Arms zones (A, B and C) respectively used for calculating the data related to T- maze and Y-maze experiments (alternation triples, max. number of arm visits etc...).
Formula & Specific cases	See details about the related calculation in chapter calculations of TY
Origin of the data	Experimentation Assistant/Zones Definition/Zones - Assoc. Management/Show

	Zones-Assoc. Management dialog.../Settings for Zone Dependent Calculations/Triplet Settings
Created/Defined by	User-defined

15.5.5.5.AN. Zone Relative Time Settings

Definition: Number of zone associations contained in the Zone definition used for the analysis of the trial.

SMART modules & Extensions	CS, CPP
Reports	Summary report
Description	Name of the "distributed zone" used for calculating the relative time in zones.
Formula & Specific cases	See details about the Relative time in zones in chapter calculations of CPP
Origin of the data	Experimentation Assistant/Zones Definition/Zones - Assoc. Management/Show Zones-Assoc. Management dialog.../Settings for Zone Dependent Calculations/Relative Time Settings
Created/Defined by	User-defined

15.5.5.6.AN. Whishaw's Error Corridor Width

Definition: Number of zone associations contained in the Zone definition used for the analysis of the trial.

SMART modules & Extensions	CS
Reports	Summary report
Description	Width of the Whishaw's Error corridor used in analysis.
Formula & Specific cases	See details about the Whishaw's error corridor in chapter calculations of WM
Origin of the data	Experimentation Assistant/Analysis/Summary report/Whishaw's error/Settings associated to the selected calculation
Units	Calibration unit: cm or inches
Created/Defined by	User-defined

15.5.6. Timing

15.5.6.1.AN. Time Interval START

SMART modules & Extensions	All modules
Reports	All reports
Description	Starting time of trial analysis (respect to the starting time of the full trial) set by the user for analysis.
Origin of the data	Experimentation Assistant/Analysis/General Configuration/Time Interval/User Defined/Start
Units	HH:MM:SS,oo
Created/Defined by	User-defined

15.5.6.2.AN. Time Interval END

SMART modules & Extensions	All modules
Reports	All reports
Description	Ending time of trial analysis (respect to the starting time of the full trial) set by the user for analysis.
Origin of the data	Experimentation Assistant/Analysis/General Configuration/Time Interval/User Defined/End
Units	HH:MM:SS,oo
Created/Defined by	User-defined

15.5.6.3.AN. Time Interval SPLIT

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Activity episode list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Subinterval of time of trial analysis set by the user for analysis.
Origin of the data	Experimentation Assistant/Analysis/General Configuration/Time Interval/User Defined/Each
Units	HH:MM:SS,oo
Created/Defined by	User-defined

15.5.6.4.AN. Time Finish Mode

SMART modules & Extensions	All modules

Reports	All reports
Description	Option and configuration set by the User for setting the stopping conditions to be taken into account for analysis.
Origin of the data	Experimentation Assistant/Analysis/report definitions (select one)/Edit global analysis configuration…/General data/Stop Conditions
Created/Defined by	User-defined

15.5.7. Data filtering

15.5.7.1.AN. Anti-Vibration Filter

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Event list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Threshold of speed set for the anti-vibration filter and used for analysis.
Origin of the data	Experimentation Assistant/Analysis/report definitions (select one)/Edit global analysis configuration.../Trajectory filtering and smoothing/Apply anti-vibrations filter to all tracks
Units	cm/s or inch/s (depending of the calibration unit settings)
Created/Defined by	User-defined

15.5.7.2.AN. Anti-Artifact Filter

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Event list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Threshold of speed set for the artifact rejection filter and used for analysis.
Origin of the data	Experimentation Assistant/Analysis/report definitions (select one)/Edit global analysis configuration.../Trajectory filtering and smoothing/Apply artifact rejection to all tracks
Units	cm/s or inch/s (depending of the calibration unit settings)
Created/Defined by	User-defined

15.5.7.3.AN. Smoothing LOWESS

SMART modules & Extensions	CS, OF, PM, WM, CPP, TY, SI
Reports	Summary report, Zone transition list, Event list, TriWise rearing list, TriWise rotation list, TriWise stretching list.
Description	Status of activation of the Smoothing LOWESS option.
Origin of the data	Experimentation Assistant/Analysis/report definitions (select one)/Edit global analysis configuration.../Trajectory filtering and

	smoothing/Apply artifact rejection to all tracks
Created/Defined by	User-defined

16. SMART Experimental modules

16.1. SMART-CS: Customized test

SMART-CS module provides you with the most flexible solution to your specific experimental project. These attributes are reflected in the powerful tools provided within this module:

- Free edition of arenas, zones and associations.
- A variety of automatic stop conditions.
- Free definition of customizable analysis reports.

SMART-CS module combines perfectly with any other module or extension in the software license, enhancing the capabilities and making the solution much more productive.

SMART-CS users have the flexibility to customize an experimental file created under a specific experimental module. In this way, the ease of use and efficiency of the experimental module are combined with the powerful and flexibility of SMART-CS.

For example, the “Open Field” module can be used to create an experiment and define the standard zones very quickly. Then, the “Customized” module can be applied to define additional associations or analysis reports.

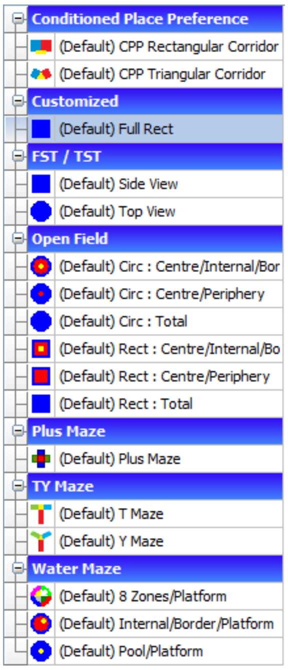
16.1.1. Detection modes

The SMART-CS module is provided with the Center of mass detection mode.

The SMART-CS module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Multi-subject detection capacities (SMART-SI)
- Global activity detection mode (SMART-GA)

16.1.2. Zone templates



Apart from a standard "Full Rect" template with a single rectangular zone, SMART-CS module provides a **combination** of all the templates included within the rest of the experimental modules active in your license.

Moreover, a set of tools to freely draw, adapt, save and load your zone definitions are provided.

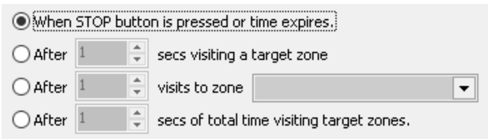
Please refer to the Chapter 7.2.3.2 for more details on these tools.

16.1.3. Specific features of zone edition

SMART-CS module allows unrestricted edition of the arenas (if SMART-MA extension is enabled), zones and associations.

Please refer to the chapter 7.2.2 for more details on this capability.

16.1.4. Stop conditions

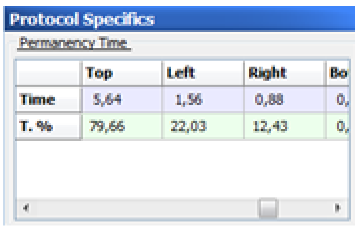


SMART-CS users are provided with the all the available stop conditions:

- Pre-Set Time / When STOP button is pressed or time expires.
- After <x> secs visiting a target zone.
- After <x> visits to zone <z>.
- After <x> secs of total time visiting target zones.

Please refer to the chapter 9.4 for more details on this capability.

16.1.5. Runtime information


Protocol Specifics

Permanency Time

	Top	Left	Right	Bo
Time	5,64	1,56	0,88	0,
T. %	79,66	22,03	12,43	0,

In addition to the general runtime information described in the chapter 13.3, SMART-CS users are provided with the following specific runtime information:

- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 13.3 for more details on general and specific runtime calculations.

16.1.6. Specific analysis calculations

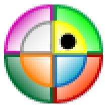
SMART-CS users are provided with a flexible, powerful and easy to use tool to freely define your own analysis reports. Each analysis report can include any of the hundreds of analysis calculations available in any of the experimental modules.

Please refer to the chapter 14.11 for more details on how to define your specific analysis reports.

Additional calculations are also provided if SMART-TW extension (for TriWise data acquisition and analysis), SMART-GA extension (for global activity acquisition and analysis) and SMART-SI module (for multiple subjects tracking and for social interaction tests calculations) are active in the SMART license.

Please refer to the chapter 15 for more details on all the calculations provided by SMART-CS.

16.2. SMART-WM: Water Maze test



For nearly two decades the Water Maze is a task extensively used and accepted by behavioral researchers to assess and compare learning and memory in rodents.

While simple at first glance, the Water Maze test employs a variety of sophisticated mnemonic processes. These processes encompass the acquisition and spatial localization of relevant visual cues which are subsequently processed, consolidated, retained, and then retrieved, in order to success fully navigate and thereby locate a hidden platform to escape the water.

Primarily designed to measure spatial learning and recall, the Water Maze test procedure has now become quite useful for evaluating the effects of aging, experimental lesions, and drug effects in rodents. Several lines of evidence also confirm the usefulness of the model for research relevant to the study of neurodegenerative diseases, such as Alzheimer's and Parkinson's, which feature cognitive decline.

16.2.1. Detection modes

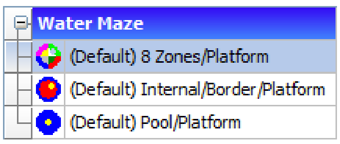
The SMART-WM module is provided with the Center of mass detection mode.

The SMART-WM module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

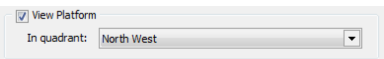
16.2.2. Zone templates

SMART-WM users are provided with a set of preconfigured standard zone definitions for Water Maze experimental areas:



Default zone template	Defined associations
8 zones/Platform	Quadrant NE, Quadrant SE, Quadrant SW, Quadrant NW, Border, Total
Internal/Border/Platform	Pool, Total
Pool/Platform	Total

16.2.3. Specific features of zone edition

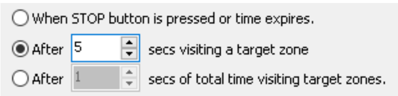


- Platform can be shown or hidden depending on your needs. A specific quadrant must be selected if the platform is shown.
- Platform can be displaced only within the limits of the selected quadrant or within the pool.
- Quadrants and border zones can be resized but not individually (always in group).

- Zones can be freely displaced and rotated but not individually (always in group).

Please note that the specific features provided depend on the zone template applied in each case.

16.2.4. Stop conditions

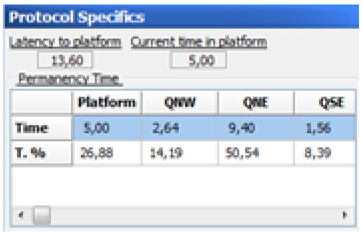


In addition to the general stop condition, SMART-WM users are provided with the following specific stop conditions:

- After <x> secs visiting a target zone.
- After <x> secs of total time visiting target zones.

The zone "Platform" is always considered the target zone.

16.2.5. Runtime information



In addition to the general runtime information described in the chapter 13.3, SMART-WM users are provided with the following specific runtime information:

- Latency to platform (if platform is defined).
- Current time in platform (if platform is defined).
- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.2.6. Specific analysis calculations

A specific analysis report "Report Water Maze" is provided to SMART-WM users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Zone Transition list
- Association Transition list
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)

Additionally, the following specific calculations are provided within the "Summary" report:

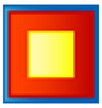
- Latency to target.
- Latency 1st entrance to target.
- Target crossings.
- Distance to target.
- Mean distance to target.
- Mean directionality.

Following reports are also available for SMART-WM users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.3. SMART-OF: Open Field test



The standard Open Field test is commonly used to assess locomotor, exploratory and anxiety-like behavior in laboratory animals. This test is particularly useful in evaluating the effects of anxiolytic and anxiogenic drugs, locomotor responses to drug and as well as behavioral responses to novelty.

The Open Field area generally consists of an empty and bright square (or circular) arena, surrounded by walls to prevent animal from escaping. The animal is usually place in the center of the arena and its behavior recorded over a chosen period (from 3 to 15 min). The Open Field test task approaches the conflict between the innate fear that rodents have of the central area of a novel or brightly lit open field versus their desire to explore new environments. When anxious, the natural tendency of rodents is to prefer staying closed to the walls (thigmotaxis). In this context, anxiety-related behavior is measured by the degree to which the rodent avoids the center of the Open Field test.

16.3.1. Detection modes

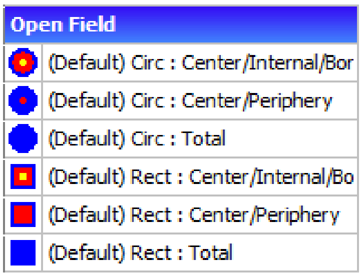
The SMART-OF module is provided with the Center of mass detection mode.

The SMART-OF module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

16.3.2. Zone templates

SMART-OF users are provided with a set of preconfigured standard zone definitions for Open Field experimental areas:



Default zone template	Defined associations
Circ: Center/Internal/Border	Periphery, Total
Circ: Center/Periphery	Total
Circ: Total	Total
Rect: Center/Internal/Border	Periphery, Total
Rect: Center/Periphery	Total
Rect: Total	Total

16.3.3. Specific features of zone edition

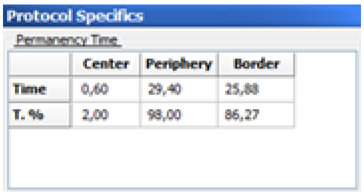
- Only the "Center" zone can be individually displaced. The rest of the zones are always displaced together.
- A zone cannot be displaced nor resized outside its containing zone.

Please note that the specific features provided depend on the zone template applied in each case.

16.3.4. Stop conditions

There are no specific stop conditions provided to the SMART-OF users; the general stop conditions are sufficient.

16.3.5. Runtime information



Protocol Specifics

Permanency Time

	Center	Periphery	Border
Time	0,60	29,40	25,88
T. %	2,00	98,00	86,27

In addition to the general runtime information described in the chapter 13.3, SMART-OF users are provided with the following specific runtime information:

- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.3.6. Specific analysis calculations

A specific analysis report "Report Open Field" is provided to SMART-OF users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Zone Transition list
- Association Transition list
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)

Specific analysis calculations are provided with this report.

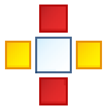
- Parallel index
- Turning tendency

Following reports are also available for SMART-OF users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.4. SMART-PM: Elevated Plus Maze test



The standard Elevated Plus Maze test is commonly used to assess anxiety-like behavior in laboratory animals.

The maze is usually a cross shaped elevated maze, with two open arms and two closed arms. The elevated plus maze task approaches the conflict between the innate fear that rodents have of open areas versus their desire to explore new environments. Security is provided by the closed arms whereas the open arms offer exploratory value. When anxious, the natural tendency of rodents is to prefer enclosed dark spaces to opened brightly lit spaces. In this context, anxiety-related behavior is measured by the degree to which the rodent avoids the unenclosed arms of the maze.

The Elevated Plus Maze test is particularly useful in evaluating the effects of anxiolytic and anxiogenic drugs. This paradigm is also of interest in the perspective to identify putative anxiety-like phenotypes in transgenic or knock-out mice.

16.4.1. Detection modes

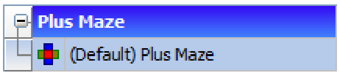
The SMART-PM module is provided with the Center of mass detection mode.

The SMART-PM module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

16.4.2. Zone templates

SMART-PM users are provided with a single preconfigured standard zone definition for Plus Maze experimental areas:



Default zone template	Defined associations
Plus maze	Open arms, Closed arms, Total

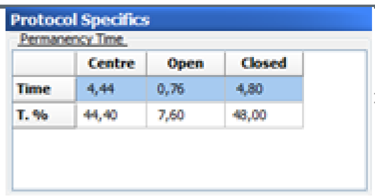
16.4.3. Specific features of zone edition

- Zones can be displaced and rotated but not individually (always in group).
- Arms and center zones can be individually resized.
-

16.4.4. Stop conditions

There are no specific stop conditions provided to the SMART-PM users; the general stop conditions are sufficient.

16.4.5. Runtime information



Protocol Specifics

Permanency Time

	Centre	Open	Closed
Time	4,44	0,76	4,80
T. %	44,40	7,60	48,00

In addition to the general runtime information described in the chapter 13.3, SMART-PM users are provided with the following specific runtime information:

- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.4.6. Specific analysis calculations

A specific analysis report "Report Plus Maze" is provided to SMART-PM users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Zone Transition list
- Association Transition list
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)

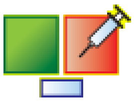
Specific analysis calculations are not included for this report (all are considered as general analysis calculations).

Following reports are also available for SMART-PM users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.5. SMART-CPP: Conditioned Place Preference Test



The conditioned place preference (CPP) test is commonly used to assess preferences for an environment that have been associated with a reward in rodents.

The experimental box consists in two compartments that differ by visual and tactile cues. In a preconditioning session, animals are allowed to freely explore the apparatus. During conditioning, a drug is administered to the subjects, which are then confined in one assigned compartment.

Finally, the post-conditioning test consists in giving the subjects a free access to the whole apparatus. The amount of time spent in the conditioned compartment is recorded. If the drug has marked rewarding properties, the animal will spend more time in the compartment with which it was paired to the drug.

The conditioned place preference procedure is classically used to test the addictive liability of putative drugs of abuse in research as well as in pharmaceutical industry.

16.5.1. Detection modes

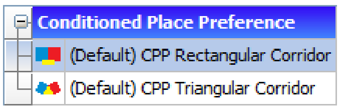
The SMART-CPP module is provided with the Center of mass detection mode.

The SMART-CPP module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

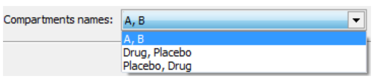
16.5.2. Zone templates

SMART-CPP users are provided with a set of preconfigured standard zone definitions for CPP experimental areas:



Default zone template	Defined associations
CPP Rectangular Corridor	Total
CPP Triangular Corridor	Total

16.5.3. Specific features of zone edition

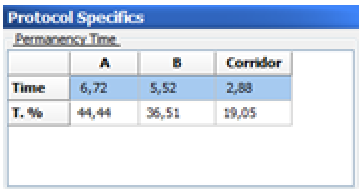


- Compartment names must be selected from a list (A/B, Drug/Placebo or Placebo/Drug).
- Corridor and compartments can be individually displaced and resized but the corridor must always overlap both compartments.
- Zones can be freely rotated but not individually (always in group).

16.5.4. Stop conditions

There are no specific stop conditions provided to the SMART-CPP users; the general stop conditions are sufficient.

16.5.5. Runtime information


Protocol Specifics
Permanency Time

	A	B	Corridor
Time	6,72	5,52	2,88
T. %	44,44	36,51	19,05

In addition to the general runtime information described in the chapter 13.3, SMART-CPP users are provided with the following specific runtime information:

- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.5.6. Specific analysis calculations

A specific analysis report “Report Conditioned Place Preference” is provided to SMART-CPP users including the following base reports described in chapter 14.11.2:

- Summary Report – tracking standards
- Zone Transition List
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)

Additionally, the following specific calculations are provided within the “Summary” report:

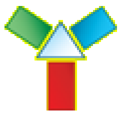
- Relative Time In Zone.
- Relative Time In Zone (%).

Following reports are also available for SMART-CPP users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.6. SMART-TY: T/Y Maze Test



The T or Y-maze can be used in various behavioral tests that commonly assess learning and memory in rodents. Alternation behavior is based on the natural tendency in rodents to explore the maze systematically entering each arm in turn and is exploited in both spontaneous alternation and delayed alternation tasks.

- In the *spontaneous alternation task*, the animal can be placed in a Y maze and allowed to move freely through the maze. Alternation behavior is then defined as consecutive entries into each of the three arms without repetition. Alternatively, the animal can be placed at the end of one arm and in the start arm of the T-maze and allowed to explore one of the two (non-reinforced) arms. The subject is then returned to the start arm and will typically choose to explore the alternate arm, which will correspond to a correct choice.

- In the more complex *delayed alternation task*, the animal is firstly placed in the start arm of the T/Y-maze and has to choose one of two baited arms. Once the choice made, the subject is removed and after a variable delay, returned in the start arm. The arm, opposite to which the animal had chosen on the previous trial, is now the only one baited. The animal makes a correct choice if the first arm chosen is the baited arm. This pair of trials is repeated many times daily to make the number of errors significantly decrease.

The ability to alternate requires that the animal know which arms have already been visited. Therefore, spontaneous and delayed alternation tasks can be regarded as a measure involving spatial working memory and are often used to assess hippocampal and forebrain function.

16.6.1. Detection modes

The SMART-TY module is provided with the Center of mass detection mode.

The SMART-TY module can be extended to the following detection modes:

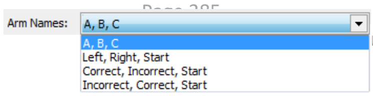
- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

16.6.2. Zone templates

SMART-TY users are provided with a set of preconfigured standard zone definitions for T/Y maze experimental areas:

Default zone template	Defined associations
T Maze	Total
Y Maze	Total

16.6.3. Specific features of zone edition

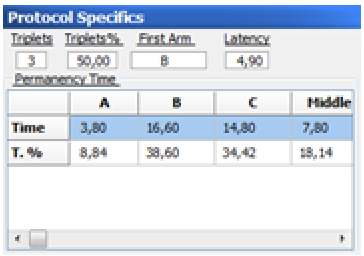


- Arm names must be selected from a list (A/B/C, Left/Right/Start, Correct/Incorrect/Start, Incorrect/Correct/Start).
- Zones can be freely displaced and rotated but not individually (always in group).
- Arm zones can be individually resized.

16.6.4. Stop conditions

There are no specific stop conditions provided to the SMART-TY users; the general stop conditions are sufficient.

16.6.5. Runtime information



In addition to the general runtime information described in the chapter 13.3, SMART-TY users are provided with the following specific runtime information:

- Alternations Triplet (and %).
- First arm visited.
- Latency to first arm visited.
- Time in zone and association (and %).
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.6.6. Specific analysis calculations

A specific analysis report "Report TY Maze" is provided to SMART-TY users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Zone Transition List
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)

Additionally, the following specific calculations are provided within the "Summary" report:

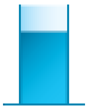
- 1^{st} Arm Choice.
- 1^{st} Arm Choice Latency.
- Alternations Triplet.
- Alternations Triplet (%).
- Max Alternations Triplet.
- Total Arm Entries.
- Relative Time In Zone.
- Relative Time In Zone (%).

Following reports are also available for SMART-TY users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.7. SMART-FST: Forced Swimming test



The Forced Swimming test is a so-called "behavioral despair" model and is commonly used for the screening of antidepressant drugs. They are based on a common phenomenon: a normal animal submitted to a non-soluble aversive situation alternates between agitation and immobility. The reason of agitation is searching, it is highly energy consuming, while the purpose of immobility is energy conservation.

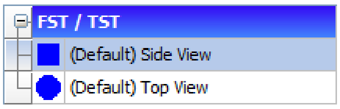
After antidepressant treatment, animals struggle more even in a desperate situation, and spend less time immobile. Some aspects of neurotic depression can be studied with the aid of these models.

16.7.1. Detection modes

The SMART-GA module is provided with the Activity detection mode and cannot be extended to any of the tracking modes.

16.7.2. Zone templates

SMART-FST users are provided with a set of preconfigured standard zone definitions for FST/TST experimental areas:



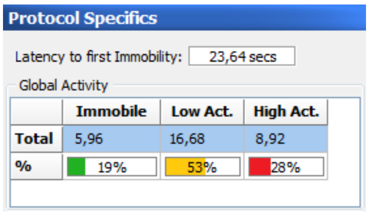
Default zone template	Defined associations
Side View	None
Top View	None

16.7.3. Specific features of zone edition

- A single zone is provided to analyze the activity of a subject in a particular cylinder (FST) or compartment (TST).
- That zone can be freely displaced, resized and rotated.
- SMART-MA extension is highly recommended to boost the performance of your FST/TST experiments in order to analyze the activity of more than one subject at the same time.

16.7.4. Stop conditions

There are no specific stop conditions provided to the SMART-FST users; the general stop conditions are sufficient.



16.7.5. Runtime information

SMART-FST module automatically enables the SMART-GA extension (global activity detection mode) of SMART and disables the tracking capabilities. Please refer to the chapter 8.2 for more details on the different detection modes available.

SMART-FST users are provided with the following specific runtime information in addition to the general runtime information described in the chapter 13.3.

- Latency to the first immobility episode.
- Activity level in zone (and %): immobile, low and high activity.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.7.6. Specific analysis calculations

A specific analysis report "Report FST/TST" is provided to SMART-FST users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Event list
- Activity episode list (SMART-GA)

Additionally, the following specific calculations are provided within the "Summary" report:

- Global Activity Total.
- Global Activity In Zone (and %).
- Immobile Time Total (and %).
- Immobile Time In Zone (and %).
- Low Activity Time Total (and %).
- Low Activity Time In Zone (and %).
- High Activity Time Total (and %).
- High Activity Time In Zone (and %).
- Immobility Events.
- Low Activity Events.
- High Activity Events.
- Latency To 1st Immobility.
- Mean Duration Immobility Events.
- Mean Duration Low Activity Events.
- Mean Duration High Activity Events.

Following reports are also available for SMART-FST users:

- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

16.8. SMART-SI: Social Interaction

Social behaviors can be defined as all behavior that influences, or is influenced by, other members of the same species. The term thus refers to all behaviors tending to bring individuals together, such as sniffing, nipping, grooming, following, kicking, boxing, wrestling, jumping on, crawling over or under the partner for example.

Nowadays, it is generally recognized that social interactions are not unitary behaviors with a single neurological basis, but different features underlie social behavior, involving different neural and endocrine bases. Growing knowledge of these mechanisms triggering social behavior is essential, regarding their implication in pathologies, such as autism or schizophrenia, in which social behavior is altered.

In laboratory rodents, basal social behavior can therefore be examined in different situations, such as in a simple social interaction test by pairs of subjects or in more complex situations involving memory processes in particular.

Here two examples of experiments in which the SMART-SI module can be used:

Social interaction dominance test (resident test)

The social interaction test by pairs provides a popular and standard paradigm to study general social behavior. This test consists in allowing the experimental subject freely exploring an unfamiliar congener in its home cage or in a neutral environment. Social exploration is measured by the time spent by the experimental subject around the congener as well as the amount and duration of behaviors that compose social interaction (e.g. sniffing, following, allogrooming, biting, mounting, wrestling…). Social avoidance behavior is used in a wide variety of models, for instance for assessing neophobia anxiety and depression-like behaviors.

Social Transmission of food preference test

Social transmission of food preference is a test that is used in rodents to assess memory processes as well as social interaction ability. The test is based on the fact that rodents are able to learn about potential food sources by sampling those sources on the breath of littermates. This task requires a demonstrator, previously exposed to a scented food, which interacts with an observer to transmit it its food exposure experience. If social transmission of food preference has occurred, the observer will preferentially consume the same diet that was fed to the demonstrator when it is confronted to a choice.

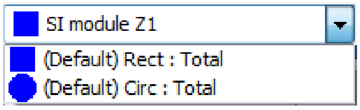
16.8.1. Detection modes

The SMART-SI module is provided with the Center of mass detection mode.

The SMART-SI module can be extended to the following detection modes:

- TriWise Tracking detection mode (SMART-TW)
- Color Tracking detection mode (SMART-TW)
- Global activity detection mode (SMART-GA)

16.8.2. Zone templates



SMART-SI users are provided with a set of preconfigured standard zone definitions for Open Field experimental areas:

Default zone template	Defined associations
Rect: Total	None
Circ: Total	None

16.8.3. Specific features of zone edition

- Zones can be freely displaced, resized and rotated.
-

16.8.4. Stop conditions

There are no specific stop conditions provided to the SMART-SI users; the general stop conditions are sufficient.

16.8.5. Runtime information

In addition to the general runtime information described in the chapter 13.3, SMART-SI users are provided with the following specific runtime information:

- Total number of contacts registered in the trial
- Activity in zone and association (and %), only if the **Global Activity** detection mode is enabled.

Please refer to the chapter 15 for more details on general and specific runtime calculations.

16.8.6. Specific analysis calculations

A specific analysis report "Report Social Interaction" is provided to SMART-SI users including the following base reports described in Chapter 14.11.2:

- Summary Report – tracking standards
- Event list
- Speed Episode List
- Activity Episode List (SMART-GA)
- TriWise Rotation List (SMART-TW)
- TriWise Rearing List (SMART-TW)
- TriWise Stretching List (SMART-TW)
- Relative Position Event list (SMART-SI)

Additionally, the following specific calculations are provided within the "Summary" report:

- Contacts Number Total – Trial
- Contacts Number Total – Subject

Following reports are also available for SMART-SI users:

- Track Coordinates Report.
- Global Activity Raw Data Report (SMART-GA)
- Group Evolution Graph.

Please refer to the chapter 15 for more details on all the calculations provided by this module.

17. SMART extensions

17.1. Multiple Arena (SMART-MA)

Experiments carried out simultaneously generate results more expeditiously than those performed in succession. Using multiple arenas can greatly increase productivity by reducing the time spent on each experiment, as it makes it possible for you to acquire data from several arenas (virtually unlimited) at the same time.

The main capabilities provided by the SMART-MA extension described along this User's Manual are now summarized.

17.1.1. Compatible smart experimental modules

The SMART-MA extension can be used in combination with the whole range of SMART experimental modules:

- Customized (SMART-CS)
- Water maze (SMART-WM)
- Open-field (SMART-OF)
- Plus maze (SMART-PM)
- T/Y maze (SMART-TY)
- Conditioned place preference (SMART-CPP)
- Forced swimming test/tail suspension test (SMART-FST)
- Social Interaction (SMART-SI)

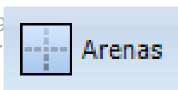
17.1.2. Arena selector

SMART-MA users are provided with a powerful tool called "Arena selector". This tool is available in a variety of windows along the application and allows you to identify which arena is currently selected and also to select a different one by using the arrow buttons or the dropdown list.

As each arena is an entirely independent data acquisition and analysis unit, each of them could have independent settings:

- Zones definition
- Detection settings
- Image Brightness and contrast settings
- Time settings
- Trial schedule
- Runtime information
- Trial control (start/stop)
- Event marker settings
- Atlantis settings

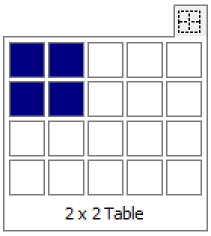
17.1.3. Arena definition tool



SMART-MA users are provided with an exclusive button "Arenas" located in the **Experimentation Assistant** bar. This button gives access to the arena definition tool which enables you to easily define one or multiple arenas at the same time.

Please refer to the chapter 7.2.2 for more details on how to define multiple arenas.

17.1.4. Arena drawing tools



SMART-MA users are provided with a set of tools to quickly draw one or multiple arenas and adjust to desired boxes, mazes or apparatus in general.

All the arenas drawn are stored and retrieved within the same zones definition.

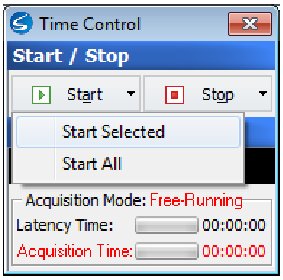
Please refer to the chapter 7.2.2 for more details on how to draw multiple arenas.

17.1.5. Distribution of subjects into arenas

When defining the plan of the experiment (Scheduler) the trials, SMART-MA users are provided with a tool to automatically distribute a set of experimental subjects into the defined arenas.

Please refer to the chapter 11.2.5 for more details on how to use this tool.

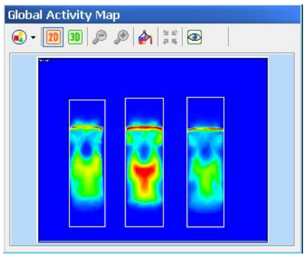
17.1.6. Multiple execution of trials



SMART-MA users are provided with specific controls to start and stop arenas individually and also simultaneously.

Start and **Stop** buttons provide a drop down menu with the **Start all / Stop all** option to start or stop all arenas simultaneously without having to select them manually.

Please refer to the chapter 13.7 for more details on how to start and stop trials.



17.2. Global Activity (SMART-GA)

Activity measurement is the task of detecting animal movements even without displacement. The activity is evaluated by counting the pixels change rate between two consecutive images. Unlike the Tracking mode, all the pixels detected are taken into account allowing a fine evaluation in the change of the animal shape.

The main capabilities provided by the SMART-GA extension described along this User's Manual are now summarized.

17.2.1. Compatible smart experimental modules

The SMART-GA module is intrinsically used in the Forced-swimming test SMART module (SMART-FST).

The SMART-GA extension can also be used in combination with the following SMART experimental modules:

- Customized (SMART-CS)
- Water maze (SMART-WM)
- Open-field (SMART-OF)
- Plus maze (SMART-PM)
- T/Y maze (SMART-TY)
- Conditioned place preference (SMART-CPP)
- Social Interaction (SMART-SI)

17.2.2. Activity detection mode

SMART-GA users are provided with tools to select which information is relevant to their specific needs so that the hard disk, memory and performance requirements can be minimized.

The **Activity Detection** mode of the **Detection Settings** panel enables the acquisition of the global activity measurement along the time. If your experimental paradigm is based on the activity of the subject, check this box. Additional configuration tools are provided to adjust the settings to assess the subject's activity level and test the activity detection process.

Please refer to the chapter 8.2.5 for more details on the global activity detection mode.

17.2.3. Runtime activity information

SMART-GA users are provided with detailed information about the general activity of the subjects assessed during the data acquisition process.

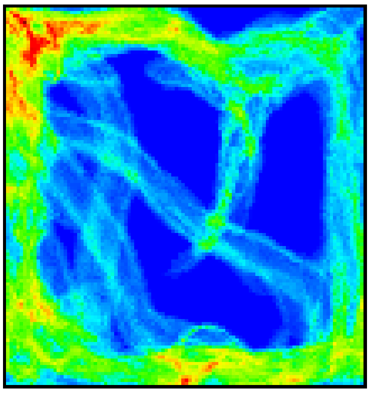
Protocol Specifics

Permanency Time and Global Activity

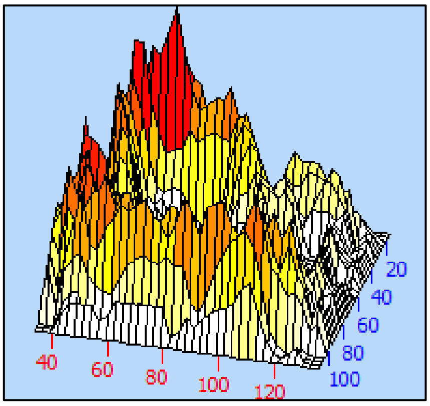
	Border-P	Centre	Periphery	Tot
Time	0,96	0,00	5,32	5,3
T. %	18,05	0,00	100,00	100,
Activity	378,53	6,71	2158,75	216
A. %	17,48	0,31	99,69	100,

The activity status field represents the level of the subject's general activity depending on the activity thresholds adjusted in the **Activity Settings** panel.

The **Global Activity Map** tool is a basic visual tool showing an illustrative view of the zones of maximal activity achieved along the acquisition process. This tool does not generate any numeric data that could be used for calculations or statistics.



2D activity map



3D activity map (the same as 2D)

Please refer to the chapter 13.3 for more details on the runtime activity information.

17.2.4. Immobility detection

SMART-GA users are provided with the **Immobility detection** tool which automatically identifies and records the episodes of immobility in experiments such as forced-swimming test (FST) and fear conditioning.

Please refer to the chapter 13.3.2.1 more details on how to configure and use the immobility detection tool.

17.2.5. Global activity analysis

Trials captured with the global activity detection mode enabled can be re-analyzed using a different configuration of the **Activity Thresholds** and **Immobility detection** tool.

Please refer to the chapter 14.11.4.3 more details on how to configure the global activity analysis process.

SMART-GA extension also provides you with a relevant set of analysis calculations and base reports in addition to those provided by other modules active in the SMART license. Please refer to the chapter 15.3.1.7 for more details on the specific analysis calculations available for this extension.

Please refer to the chapter 14.11.2.4 for more details on the "Activity Episode List" base analysis reports.

17.3. TriWise (SMART-TW)

Standard video-tracking systems use the detection of the center of mass for studying the behavior of experimental subjects in a wide variety of different tests. Nevertheless, this measuring method may be considered as insufficient in some applications with very specific needs.

The TriWise Technology is an innovation of the Panlab Harvard Apparatus Research and Development team enabling the SMART video-tracking system to extract an advanced model of the animal motion based not only on its center of mass but also on the head and tail positions.

The newly developed 3-points detection technique appears then a most relevant method in this context.

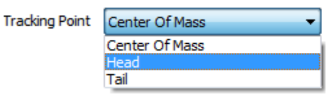
The use of this technology not only avoids having to mark the animal but also allows a more detailed evaluation of some specific behavioral items such as animal exploration (hole-board test, object recognition test, novel object test), location choice (elevated-plus maze, T/Y maze, open-field), rearing (open-field, exploration studies…) and rotations (studies using unilateral lesion of dopaminergic systems, cycling behavior).

17.3.1. Compatible smart experimental modules

The SMART-TW extension can be used in combination with the following SMART experimental modules:

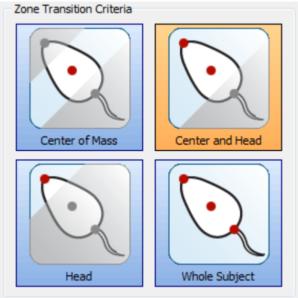
- Customized (SMART-CS)
- Water maze (SMART-WM)
- Open-field (SMART-OF)
- Plus maze (SMART-PM)
- T/Y maze (SMART-TY)
- Conditioned place preference (SMART-CPP)
- Social Interaction (SMART-SI)

17.3.2. Tracking point



SMART-TW users are provided with a configurable option to select which subject's body point (head, center of mass or tail) will be effectively tracked during the data acquisition sessions.

Please refer to the chapter 8.2.3 for more details on the tracking point.



17.3.3. Zone transition criterion

SMART-TW users are provided with a configurable option to select the criterion by which zone transitions are evaluated during the data acquisition and analysis processes.

Please refer to the chapter 8.2.3 for more details on the zone transition criterion.

17.3.4. Automatic detection of events

SMART-TW users are provided with specific tools to configure and automatically detect and register rearing, rotation and stretching events without the need of additional external devices.

17.3.5. Automatic detection of Social interaction events

When combined with the SMART-SI module for social interaction experiments, the SMART-TW extension provides more precision in the definition of contact made between 2 or more animals.

The user can set the system for the detection of contact between all the combinations of detected points: center-center, head-head, tail-tail, head-center, centre-tail, head-tail…

17.3.6. TriWise analysis

Trials captured with the TriWise detection mode enabled can be re-analyzed using a different configuration of the rearing, rotation and stretching detectors (zones definition and thresholds).

SMART-TW extension also provides you with a relevant set of analysis calculations and base reports in addition to those provided by other modules active in the SMART license. Please refer to the chapter 15 for more details on the specific analysis calculations available for this extension.

Please refer to the chapters 15.3 for more details on the base analysis reports provided with SMART-TW.

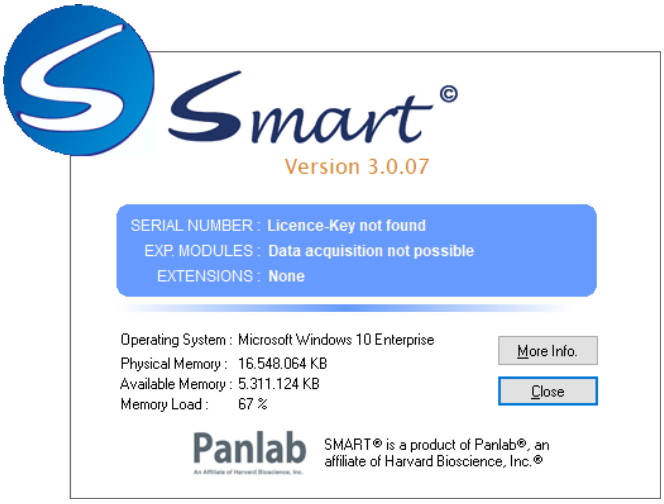
18. Software updates, upgrades and extensions

SMART software is under a constant development process reflected in new versions including new and improved features.

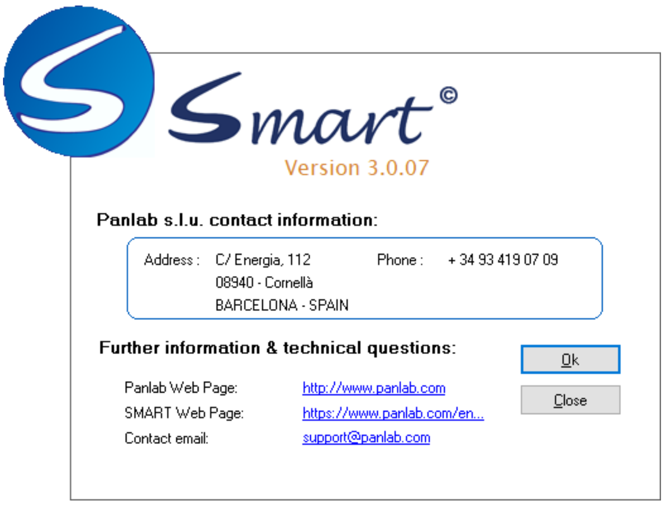
In that sense, software *updates* (small changes) and *upgrades* (relevant changes) are periodically published and available to you through our Technical Support department.

Additionally, SMART modules and extensions can be purchased and activated as your scientific needs increase. For SMART to identify the new modules and extensions licensed, a *license extension* must be executed.

The **Help – About** menu option of SMART provides you with the information related to your system (serial number and optional modules and extensions acquired).



Press the **More Info** button to get the Technical Support's contact details:



Software updates, upgrades and extensions are shipped to you by two different means:

- Electronic mail: normally used for software updates in which only some specific files are needed. Extensions are also shipped usually by electronic email.

- Standard post: normally used for software upgrades in which major changes in hardware (such as the protection key) are involved.

Due to security reasons of the Windows® operating system, a user with administrative rights is required to carry out software updates, upgrades and extensions. Please contact your IT staff before executing any of these operations in your computer.

18.1. Updating your software

If a software update is received, please proceed as described:

1. Close SMART if it is already running.

2. Back-up the SMART installation and current working files.
   As the software is to be changed, backing-up the current version will help you to come back to it again if necessary.

   Ensure that the SMART executable file (SMART.EXE), experimental files (.SME), exported zones definition (.SMZ), subject lists (.XLS) and schedulers (.SMS) and analysis reports (.XLS) are copied from the current folders to a different back-up folder.

   Please refer to the chapter 12.1 for more details on how to configure the folders in which the working files are stored by default.

3. Copy the files received following the instructions provided within the Technical Support email received.

4. Make sure that the SMART shortcuts located in the Windows® Start Menu and Desktop are pointing the right executable file.

5. Execute SMART and check the new version through the **Help – About** menu option described previously.

Now your SMART software is updated successfully.

Please note that updating software does not affect to the content of the original license key. This procedure must be carried out again every time the software is re-installed (in the same or in a different computer).

18.2. Upgrading your software

If a software upgrade is received, please proceed as described:

1. Close SMART if it is already running.

2. Back-up the SMART installation and current working files.
   As the software is to be changed, backing-up the current version will help you to come back to it again if necessary.

   Ensure that the SMART executable file (SMART.EXE), experimental files (.SME), exported zones definition (.SMZ), subject lists (.XLS) and schedulers (.SMS) and analysis reports (.XLS) are copied from the current folders to a different back-up folder.

   Please refer to the chapter 12.1 for more details on how to configure the folders in which the working files are stored by default.

3. Uninstall the current version of SMART (Only for upgrades). Access the Windows® Control Panel – Programs – Uninstall a program tool to carry out this task.

4. Install the new version delivered following the instructions described in the new SMART User Manual included in the installation key. This information is usually under the installation chapter of the User's Manual.

5. Execute SMART and check the new version through the **Help – About** menu option described previously.

Now your SMART software is upgraded successfully.

Please note that the new license key your software does not affect to the content of the original license key. This procedure must be carried out again every time the software is re-installed (in the same or in a different computer).

18.3. Extending your software license

In order to start a license extension process, contact your local dealer providing the serial number of the existing SMART installation and an electronic email address to send the corresponding files.

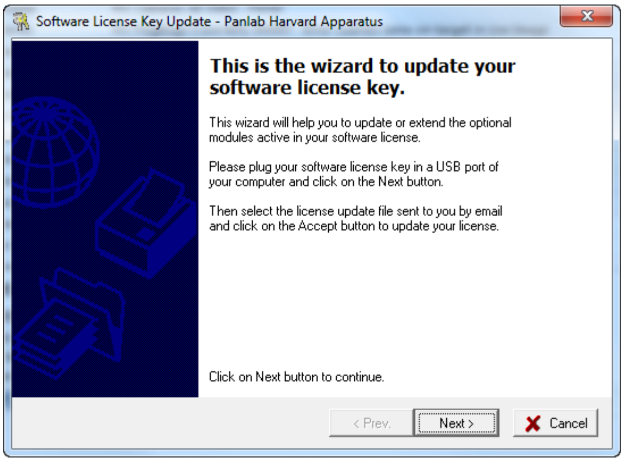
The serial number can be easily identified by means of the **Help – About** menu option described previously at the beginning of this chapter.

Once the order is properly processed, the license extension is sent by electronic email enclosing the following information:

- A license extension file (<Serial-Number>.LIC).
- The license updating tool (UpdateSoftwareKey.exe).
- The detailed instructions on how to apply the extension.

In order to apply the license extension to your current SMART license:

1. Extract the enclosed files into your Windows® Desktop following the instructions provided in the electronic mail.
2. Close SMART if it is already running.
3. Plug the proper SMART license key in a free USB 2.0 port. Make sure that the license key matches with the serial number of the license extension provided.
4. Execute the UpdateSoftwareKey.exe file extracted and press the **Next** button in the first window.



5. Select the <Serial-Number>.LIC file extracted and press the **Open** button.
6. Execute SMART and check the new licensed modules and extensions in the **Starting Assistant** panel and also through the **Help – About** menu option described previously.

Now the SMART software license is extended successfully.

Please note that extending the license affects the content of the original license key so this procedure is required only once.

19. Troubleshooting

19.1. Installation and licensing

- **The Starting Assistant does not provide me with the modules or extensions paid for.**

  Please make sure that:

  - The purchased USB flash key is properly plugged into a free USB 2.0 port.
  - The USB flash key was properly detected by your Windows® system.
  - The USB flash key contains your particular regkey.dat file within the root folder.

  For more information, please refer to the following chapters:

  - 2. Installation Overview

- **The software was updated but the old version is still running.**

  Please make sure that:

  - The software was updated properly.
  - The shortcut icons in your Windows® desktop are linked to the new version of the software.

  For more information, please refer to the following chapters:

  - 18. Software updates, upgrades and extensions

19.2. Live image and digital video files

- **My camera is not available within the Image Source list.**

  Please make sure that:

  - If a digital camera (webcam, DV or WIA-compatible in general) is used, the USB cable is properly plugged into a free USB port.
  - The drivers corresponding to the device are properly installed in the computer.

  For more information, please refer to the following chapters:

  - 2.3. Installing the image source
  - 5. Image source

- **My digital video files cannot be opened with SMART.**

  Please make sure that:

  - User has read privileges to access the digital video file from the SMART computer.
  - The codec module with which the digital video file was recorded is properly installed in the computer running SMART.
  - The digital video file was recorded with a supported codec.

  For more information, please refer to the following chapters:

  - 2.3.2. Digital video files
  - 3.2.5. Recording digital video files

- **No image (or an incorrect one) is shown in the Player panel.**

  Please make sure that:

  - The image source is properly installed, plugged and turned on and selected.
  - The cables required to connect the camera are working fine.
  - If an analogic camera is used, the lens must be opened.
  - The brightness and contrast adjustments are properly set both in the camera and in the **Detection Settings** panel.

  For more information, please refer to the following chapters:

  - 2.3. Installing the image source
  - 5. Image source
  - 8. Detection settings

19.3. Configuration

- **Tracking and/or activity detection test is erratic.**

  Please make sure that:

  - The particular setup fulfills the requirements to track the subject and/or measure activity level (camera fixing, lens, lighting conditions, digital video recorder, etc.).
  - The background image was properly captured and the arena and/or the camera have not moved during the detection or the data acquisition session.
  - The exclusion zone and the arenas have been properly defined.
  - The **Detection Settings** have been properly adjusted to detect the subject and remove undesired artifacts. If the detection fails in a particular zone of the arena, check that the special brightness and contrast in that zone is properly set.

For more information, please refer to the following chapters:

- 2.3.1.1. Camera considerations
- 3.2. Implications for experiment preparation and settings.
- 7. Zones definition
- 8. Detection settings

19.4. Data acquisition

- **A "Data acquisition is not possible without a valid USB flash key." message is shown when a trial is started.**

Please make sure that:

- The USB flash key containing a valid SMART license is properly plugged and detected by Windows® as a removable drive.
- The module used within the experimental file is licensed in the USB flash key.

For more information, please refer to the following chapters:

- 13.7. Starting and Stopping Trials

- **Start and Stop buttons are disabled.**

Please make sure that:

- A workspace has been defined for the selected arena.
- A trial has been selected as the "Next trial" for the selected arena in the **Scheduler** tool.
- The trial selected as the "Next trial" has a subject assigned.
- The trial in the selected arena is not yet started / stopped.

For more information, please refer to the following chapters:

- 7. Zones definition
- 11. Experimental scheduler
- 13.7. Starting and Stopping Trials

- **The runtime information is not properly calculated or shown.**

Please make sure that:

- The runtime panels are visible.
- The monitored trial is running.
- The proper arena is selected in the **Player** or **Runtime** panel.
- The tracking and/or activity detection is carried out properly.

For more information, please refer to the following chapters:

- 8. Detection settings
- 13.3. The Runtime Viewer panel

- **Image in the Player is not updated smoothly throughout data acquisition.**

  Please make sure that:

  - The computer fulfills the minimum requirements.
  - The drivers for the computer's graphic card are updated and properly installed.
  - No other applications running on the computer conflict with SMART.

  For more information, please refer to the following chapters:

  - 2.1. System requirements

- **The trial is started or stopped unexpectedly.**

  Please make sure that:

  - The arena's time settings are properly set to stop the trial when a condition is fulfilled.
  - The computer has enough memory (RAM and/or free hard disk space) to continue the data acquisition trial.
  - The Remote Control device is not making the trial to start or stop unintentionally.

  For more information, please refer to the following chapters:

  - 2.1. System requirements
  - 9. Time settings
  - 12.2. Teleswitch settings
  - 13.10. Computer resources monitoring

- **The trial is not stopped automatically.**

  Please make sure that:

  - The arena's time settings are properly set to stop the trial when a condition is fulfilled.
  - The zones definition applied to the arena matches with the stop condition defined.
  - The target zone (if selected for the stop condition) is properly configured in the zones definition applied.
  - The stop condition is really fulfilled before the digital video file (if used) or the pre-set time ends.

For more information, please refer to the following chapters:

- 7. Zones definition
- 9. Time settings

19.5. Data analysis

- **The analysis results are not the same as the runtime information provided at the end of the trial.**

Please make sure that:

- The zones definition, associations and zones of interest configured to analyze the trial are the same as throughout acquisition.
- The full trial interval is analyzed (not a different user-defined interval).
- The analysis configuration (stop condition, speed, activity and/or TriWise settings and trajectory filters and smoothing) is the same as throughout acquisition.

For more information, please refer to the following chapters:

- 7. Zones definition
- 9. Time settings
- 14.3. Selecting the trials to be analyzed
- 14.11.4. Global analysis configuration

20. SMART Technical specifications

Feature	Specifications
Maximum size of the experimental file	2 Gb
Maximum image acquisition frame rate	Analogic Digital Converter: 25 fps Digital Cameras: 25 fps Other digital devices: 16 fps
Video frame size	≤ 1024 x 768, recommended. Higher frame size will depend on *
Video duration	Minimum 5 sec; Maximum 2 hours (recommended). Higher duration time would depend on *
Number of arenas (only for MA extension)	Unlimited*
Number of zones per arena	255
Number of shapes per zone	Unlimited*
Arena size	Minimum 20x20 pixels
Number of subjects per experimental file	Unlimited*
Number of phases, sessions, and trials per experimental file	Max 100 trials of 2h duration (recommended). Higher number would depend on *
Digital video recording time	Limited by the hard disk space available and the PC file system** 640x480: 4 Mb/min approx.
Digital video recording frame rate	Dynamically adjusted to 5, 10, 16, 20, 25, 32 or 40 fps according to the performance of the selected image source and the configured frame rate.
Digital video recording codec	XviD
Data acquisition time per experimental file	Only tracking: 200 hours. Only activity: 70 hours. Combined: 45 hours.

(*) *Depending on the computer's resources and/or the maximum file size. Usually much larger than required.*

(**) NTFS: 4GB maximum file size,
FAT32: 4GB maximum file size.
FAT16: 2GB maximum file size.

21. Contact Information

We are available to help you with your questions and concerns. Should you hit a roadblock or need some additional training, please feel free to visit the HBIO Behavioral Support Center at https://support.behavior.hbiosci.com to find articles and helpful information in our knowledge base or submit a ticket. We are happy to help!

PANLAB

Carrer de l'Energía 112
08940 – Cornellà de Llobregat
Barcelona - SPAIN

Technical Support

Email: support@panlab.com

