RED250mobile System User Guide

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SMI
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Contents

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Welcome

Chapter

1

1. Welcome

Together with the optional SMI *Experiment Suite™*, the *RED250mobile System* provides a comprehensive toolbox for a broad range of scientific studies such as neuroscience, psychology, psychiatry and psycholinguistics.

This User Guide provides detailed instructions on the use of the *RED250mobile System*. This system includes the *RED250mobile Eye Tracker* and the *iViewRED* software, which is used to configure and run the *RED250mobile Eye Tracker*.

Document Information

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For rights and responsibilities of the use of this product, see Product Liability.

For more information, visit our home page: www.smivision.com.

Please read this User Guide carefully to ensure best results. See Precautions.

1.1 Contacting SMI

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1.3 Product Liability

SensoMotoric Instruments GmbH (SMI) does not assume liability for resultant damages to property or personal injury if the product has been misused in any way or damaged by improper use or failure to observe these operating instructions. In addition, any unauthorized modifications or repairs of the device will render the warranty null and void!

Make sure the presented visual stimuli or the environment in which you conduct your study does not harm or injure your participants. SensoMotoric Instruments GmbH (SMI) is in no way responsible for the experiments you develop, execute, and analyze. Furthermore, do not offend your participant's cultural background, age or psychological condition.

1.4 Precautions

General Precautions

Read the following carefully before using this product:

- The *RED250mobile Eye Tracker* is a sophisticated measurement device. Please handle it with care in order not to damage any of its internal components.
- When the *RED250mobile Eye Tracker* is not in use, power it off by unplugging it from the USB port and safely storing it in its case.
- Do not scratch the shield (front face) of the *RED250mobile Eye Tracker*.
- Keep the *RED250mobile Eye Tracker* away from heat sources.
- No part of the product may be modified or rebuilt.
- Any usage other than described in this manual is not permitted.

The *RED250mobile Eye Tracker* may warm up to 55°C during prolonged operation.

Magnet Precautions

Neodymium magnets (Rare Earth magnets) are used in this device to connect it to the Mounting Bracket. This allows the *RED250mobile Eye Tracker* to be easily disconnected and safely stored in its case while the Mounting Bracket stays attached to the Laptop Display or Desktop Monitor. However, because these type of magnets are extremely strong, please read the following precautions.

- Neodymium magnets are not the same as standard magnets. This type of magnet can cause injury if not used properly.

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- Neodymium magnets have strong magnetic fields and are likely to cause damage to magnetic media devices. Therefore, keep the *RED250mobile Eye Tracker* away from magnetic media such as hard drives, memory sticks, credit cards, magnetic ID cards, or other magnetic media. KEEP THE DEVICE IN ITS STORAGE CASE WHEN NOT IN USE.

- While connecting the *RED250mobile Eye Tracker* to the Mounting Bracket, the two attracting magnets have enormous strength and can severely pinch your fingers if they come between the magnets when they are connecting together.

- Gently connect the *RED250mobile Eye Tracker* to the Mounting Bracket. Neodymium magnets are prone to cracking if connected too quickly or if the device is dropped.

- Metal items, such a keys, knives, or tools may cause the magnet to shatter, if placed near enough to the magnets to cause them to connect with the magnets.

- Do not leave the *RED250mobile Eye Tracker* near an open flame or a heat source. Aside from destroying the device, the neodymium magnets may ignite, burn and create toxic fumes.

- Do not handle the *RED250mobile Eye Tracker* when eating. In the unlikely event that the magnets come in contact with food, the metal compounds in the magnets may be toxic when ingested.

Neodymium magnets should NEVER be used near a person who uses medical aids such as a pacemaker. The magnet can cause the medical aid to malfunction. Individuals with pacemakers or internal medical devices should use caution when handling the *RED250mobile Eye Tracker* and the mounting bracket. Magnetic fields may affect the operation of these devices. Consult your physician and the

manufacturer of your medical device to determine its susceptibility to static magnetic fields prior to handling the *RED250mobile Eye Tracker* and the Mounting Bracket. All of our magnetic products should be kept at a safe distance from individuals with these devices.

Keep Out of Reach of Children NEODYMIUM MAGNETS (RARE-EARTH) MAGNETS SHOULD BE KEPT OUT OF REACH OF CHILDREN. RARE-EARTH MAGNETS ARE NOT TOYS.

Children should not be allowed to handle or play with rare-earth magnets. Small magnets pose a choking hazard. Children and adults should not ingest magnets or place magnets in any body orifice such the ear, nose or mouth. Ingestion of magnets is very hazardous. If magnets are ingested or aspirated into the lungs, immediate medical attention is required. Swallowed magnets can stick together across intestines causing serious infections and death. Seek immediate medical attention if magnets are swallowed or inhaled. Children under 3 should not handle magnets, in any case.

Transportation

The International Air Transport Association (IATA) Dangerous Goods Regulations provide guidelines for the identification, classification, and testing of potentially hazardous materials offered for transports by air. IATA Packing Instruction 902 defines the acceptance criteria and provides packaging guidelines for magnetized material. These instructions should be consulted prior to transporting magnetic material

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by air. These regulations also apply to magnets built in to products such as the Eye Tracker and Mounting Bracket.

1.5 Declaration of Conformity

SMI products are for use in office environments and bear the CE mark to indicate compliance with the health and safety requirements according to European Directives. For individual product declarations please refer to sales@smivision.de.

All SMI eye tracking equipment has been tested and found to comply with the limits for Class B digital devices, pursuant to Part 15 of the FCC Rules and EMC directive 2004/108/EC, and conforms to the low-voltage directive 2006/95/EC.

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1.6 Product Maintenance

To keep the *RED250mobile Eye Tracker* in good working order, we highly recommend that you:

- Regularly clean the shield (front face) of the device using the supplied microfiber cloth.
- After using the device, store it safely in the provided case.
- Do not leave the device exposed to direct sunlight, even when not in use. Store it in the case.
- Keep liquids and other contaminants away from the device. Do not allow liquids of any kind to near or on the device to prevent permanent damage.

If the *RED250mobile Eye Tracker* becomes damaged, we highly recommend that you:

- Immediately unplug it from the USB port.
- Do not use the device until it has been repaired or replaced.

Do not attempt to repair the *RED250mobile Eye Tracker* by yourself. There are no user-serviceable parts in the device. Servicing, adjustment or repair should only be done by a certified distributor or by SensoMotoric Instruments GmbH (SMI).

1.7 Document Conventions

The following conventions are used in this document.

Italic	Indicates filenames and file extensions and, in some cases, product names.
Bold	Used for user interface buttons, selections, check boxes, application windows and screen names.
Underlined	In the PDF and Online Help version of this manual, indicates references to a related topic in this manual or to internet addresses.
	Note icon to indicate additional information.
	Warning icon to indicate reader should pay careful attention to the information.
	Reference (See Also) icon indicating a related topic.

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1.8 Glossary

BeGaze™

Software developed by SMI for analyzing eye tracking data.

Calibration

The process of adapting iViewRED's internal eye model to the unique eye characteristics of a participant.

Calibration point

A point or circle displayed on a screen for a short duration. Used during calibration.

Display, Monitor

Generally referring to the same device, but in this document a Display refers to a Laptop screen, while Monitor refers to a Desktop PC screen.

Experiment Center™

Developed by SMI, this software is an easy to operate experiment creation, planning and execution environment. It is specially designed for eye tracking studies.

Experiment Suite™

Suite of software developed by SMI that includes *Experiment Center™* and *BeGaze™*.

Fixation

Period of time during which the eyes remain relatively still and the gaze is maintained on a single location.

Gaze

The direction in which the person is looking.

Head Box

The volume in which the participant can move during the experiment, and where tracking is possible, is determined by tracking range and operating distance.

Monocular Left Tracking Mode

Tracks only on the left eye channel.

Monocular Right Tracking Mode

Tracks only on the right eye channel.

Operator

Person who is responsible for running the experiment. Also see Participant.

Operating Distance

Distance between the participant and the cameras on the eye tracker where tracking is possible.

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Participant

Person performing an experiment run by the Operator.

Reference Point

A mark on the Mounting Bracket used to align the eye tracker with the center point of the screen.

Sampling Frequency

The number of eye tracking data samples obtained in one second.

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Smart Binocular Tracking Mode

Tracking mode where both eyes are tracked. Tracking continues when one eye is closed or cannot be tracked.

Smart Calibration

With Smart Calibration enabled, the calibration process waits for required fixations for two seconds. If fixation on one calibration point is found unreliable (e.g. when the user was not really fixating that point or closing the eyes), the data from this point will not be used to establish the calibration model. The model will instead be based on data from successful calibration points.

Smart Tracking Mode

Tracking mode where *iViewRED* uses the calibration results to intelligently decide whether to use one or both eyes for tracking.

Stimulus Display

The display used for presenting the experimental stimuli to the participant during the experiment.

Tracking Mode

Setting which determines how the eye tracker will track the participant's eyes.

Tracking Range

Characterizes the surface of the plane in which eyes are detected by the eye tracker.

Validation

Uses a new set of points to verify the accuracy of the calibration results.

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System Overview

Chapter

2

2. System Overview

The SMI *RED250mobile System* is a mobile eye tracking lab for demanding paradigms. This makes it ideal for demanding applied studies such as reading and linguistics, as well as visual perception or neurology. It is fully mobile and ready to use inside and outside of the lab.

The *RED250mobile System* consists of the ultra-light USB powered, fully portable *RED250mobile Eye Tracker* and the *iViewRED* software to configure the *RED250mobile Eye Tracker* for use with a participant as well as a dedicated, SMI-certified Laptop configured for use with the *RED250mobile Eye Tracker*.

SMI Experiment Suite™ is available as a recommended complementary software package for experiment design and analysis.

See also *Experiment Center*™ and *BeGaze*™ User Guides.

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2.1 System Requirements

You can install and run *iViewRED* on a PC of your choice. However, you must be aware that the quality of the recording cannot be guaranteed on your own PC, as it would be the case on SMI's certified RED PCs.

In this section we provide guidelines and hardware requirements for using *iViewRED* on your PC. SMI, of course, cannot guarantee that a particular Laptop or Desktop PC running Windows7™ or Windows 8™ will be sufficient. It is possible that other hardware components or software on a particular PC may interfere with the functioning of *iViewRED* software. In short, if you plan on using *iViewRED* on a PC other than an SMI-provided PC, it is possible that the recording output may be a lower quality.

The following instructions in this section are guidelines only on how to set up your PC.

Requirements

Operating system:	Windows 7™ (32 or 64 bit), Windows 8™ (32 or 64 bit), Windows 8.1™ (32 or 64 bit)
Operating system Language:	*iViewRED* has been tested to run with English and German language Windows™ operating systems. *iViewRED* is not guaranteed to work with other languages.
Disk Space:	300 MB free space for *iViewRED*. Additional disk space is required for data recording and analysis.
CPU:	Quad-core Intel Core i5 or i7 of 3rd and 4th generation (Core 3xxx and 4xxx series).

USB:	USB 2.0 port required.

PC Configuration Recommendations

Depending on your use case, we highly recommend that you configure your PC based on the following specifications.

User Account Rights:	Administrator rights are required for installing *iViewRED*.
Standby Mode:	Disable the Standby Mode.
Screen Saver:	Disable the screen saver.
Power Options:	Disable any function that will power-down the PC after a period of inactivity.
Display:	Set to **Never turn off**.
Sleep:	Set to **Never put the computer to sleep**.
Power Plan:	Set to **High Performance**.
Closing the Lid:	Set to **Do nothing**.
Windows Updates:	During recording sessions only: Set to **Never Check for Updates.**
Antivirus Software:	Add *iViewRED* to exception list. Contact SMI for Antivirus Software recommendations. During recording sessions only: Turn off scheduled updates. Deactivate virus scanning.

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USB Devices:	Do not use any other USB devices on the same USB controller as the *RED250mobile Eye Tracker* during the recording.
Other Software / Applications:	Do not use additional applications that consume CPU or USB resources on the PC, since they might have an impact on the eye tracker performance.
Firewall and Networking:	Adapt the firewall and network settings so that *iViewRED* can run properly.
Write Access:	Ensure the operator has write access to the repository directory. Do not try to write to a folder for which you do not have write access.

2.2 RED250mobile Eye Tracker

The *RED250mobile Eye Tracker* is a light, scientific-grade mobile device that can be used inside or outside a lab and in environments familiar to participants. It is connected to a USB 2.0 port on the Laptop or PC running *iViewRED*, which also provides a power supply to the device.

It is mounted on the bottom frame of a Laptop Display or Desktop Monitor and can be easily removed for storage in the provided protective case.

Important Note About USB Ports: The *RED250mobile Eye Tracker* is optimized for operation on a USB 2.0 port.

See Mounting the Eye Tracker

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Technical Specifications

Sampling frequency:	60 Hz, 120 Hz and 250 Hz
Eye tracking mode:	Smart Binocular, Monocular Left, Monocular Right and Smart Tracking
Gaze position accuracy:	0.4°
Spatial resolution (RMS):	0.03° (human)
Calibration:	0, 1, 2, 5, 9, 13 Points. Smart Calibration technology.
Operating distance:	50 cm to 80 cm
Tracking range:	32 cm x 21 cm at 60 cm distance
Interfacing:	8 TTL
Operator feedback:	Eye Images, Eye Tracking Monitor
Interface setup:	Use with Desktop Monitor (10” to 24”) or Laptop Display (10” to 24”)
Operating system:	Microsoft™ Windows™ 7, Windows™ 8, Windows™ 8.1
PC Interface / power:	USB 2.0 / Power over USB
Blink recovery time:	4 ms @ 250 Hz

Dimensions (W x H x D):	24 cm x 2.7 cm x 3 cm
Weight:	175 g incl. USB cable
Software compatibility:	SMI Experiment Suite, free SMI Software Development Kit (SDK) and all software building on the SDK. SMI SDK allows integration with popular stimulus software (for example, MATLAB, PST E-Prime©, Python, NBS Presentation®) and custom applications written in, for example, C/C++ and .NET.
Eyewear compatibility:	Works robustly with most glasses and lenses
Norm compliance:	CE/FCC, Eye Safety EN62471 and EN61000-6-3/A1

2.3 iViewRED Software

iViewRED is the controller software for the *RED250mobile Eye Tracker*. It is available as a free download from the SMI website and installed prior to connecting the *RED250mobile Eye Tracker* to the PC and mounting it.

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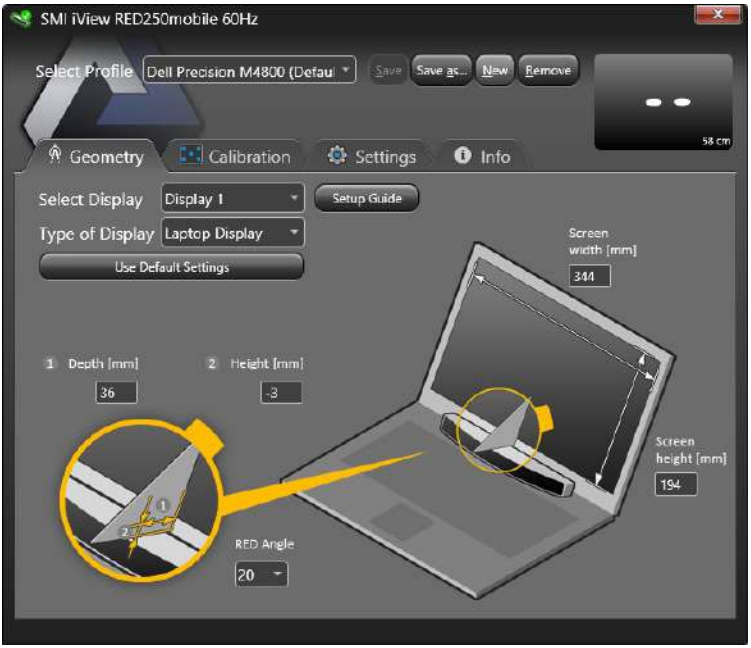

iView RED Start Screen

For an overview of *iViewRED*, see iViewRED Software Overview.

For installation instructions, see Installing iViewRED Software.

2.4 Accessories

The *RED250mobile System* includes the following accessories:

- A sturdy carrying case to protect the *RED250mobile Eye Tracker* and its accessories.
- A Mounting Bracket with a 20° angle. Additional Mounting Brackets are available as an option with a 15°angle and a 25° angle.
- Set of Mounting Strips to attach the *RED250mobile Eye Tracker* to either a Laptop Display or Desktop Monitor.
- Positioning triangle for mounting the *RED250mobile Eye Tracker*.
- Grease Removal Pads to clean the mounting surface prior to mounting the *RED250mobile Eye Tracker.*
- Microfiber cleaning cloth to clean the face of the *RED250mobile Eye Tracker*.
- SMI-certified *RED250mobile* Laptop in Flight Case.

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2.5 Optimal Conditions

To ensure optimal operating conditions throughout the experiment, we recommend:

- Participant should sit in the center of the Head Box area so that the participant has flexibility of movement during the experiment.
- Minimize any interference from direct sunlight on the *RED250mobile Eye Tracker*.
- Do not use the *RED250mobile Eye Tracker* in conditions where the participant's pupils would dilate and contract frequently, such as bright lights switching on and off frequently.
- Do not cover or block the *RED250mobile Eye Tracker* when it is powered up and is connected to a PC or Laptop running *iViewRED*.
- For best results, the brightness of the background color for the calibration process should be similar to the average brightness of the stimuli shown during the experiment.

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iViewRED Software Overview

Chapter

3

3. iViewRED Software Overview

The *iViewRED* is the controller software that is used with the *RED250mobile Eye Tracker*. This software is designed to allow an operator to quickly prepare the *RED250mobile Eye Tracker* for experimentation.

3.1 Geometry Tab

The **Geometry** tab is shown by default when *iViewRED* starts. A set of measurement fields are provided for entering the geometry measurements for either a Laptop Display or a Desktop Monitor and the relative position of the *RED250mobile Eye Tracker* to the display. This can be done manually or assisted automatically.

These measurements are required to ensure optimal mapping of the eye tracking data to the stimulus display.

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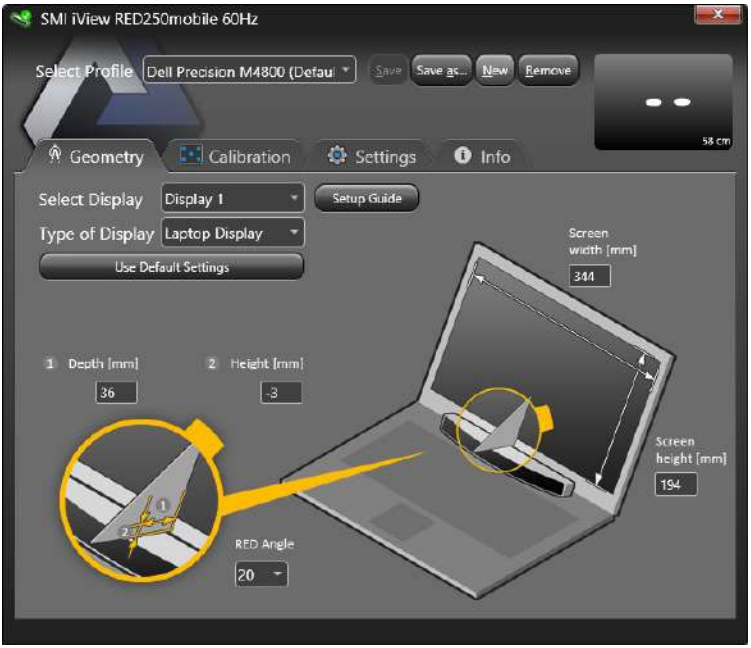
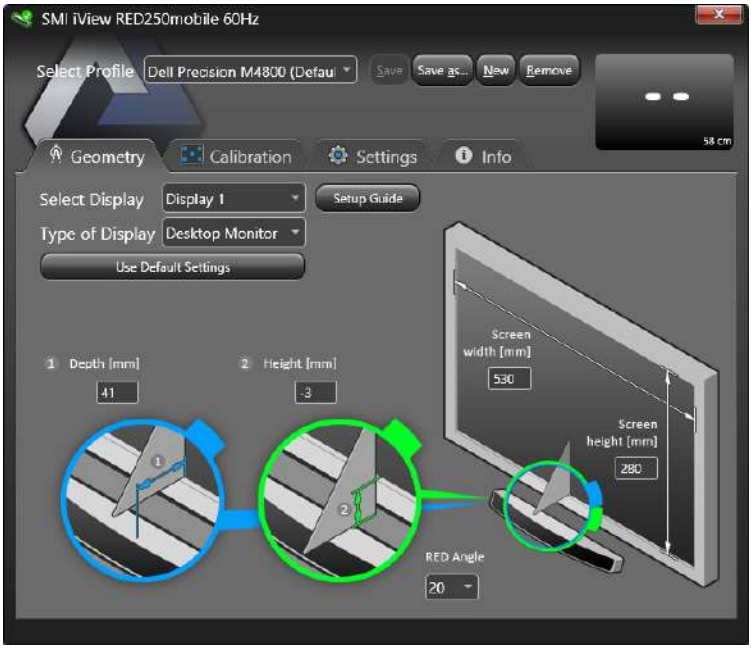


Geometry Tab showing the Laptop settings



Geometry Tab show ing the Desktop Monitor settings

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Tab Options:

Select Display:	Selection is possible only if two displays are connected to a single PC (or an additional display is connected to the Laptop). Select the display to which the *RED250mobile Eye Tracker* is mounted.
1-2 Button:	Shown only if a second display is connected to the Laptop or Display. When clicked, identifiers are shown on the displays to indicate which is Display 1 and Display 2, as defined by the Windows™ operating system.
Type of Display:	Changes the **Geometry** tab to the respective fields of the selected display type.
Use Default Settings:	Automatically detects **Screen width** and **Screen height** of the Display and sets the **Depth** and **Height** measurements to the default values of the SMI supplied laptop.
Setup Guide:	Dims the screen and displays a vertical line at the center point of the screen for use when mounting the *RED250mobile Eye Tracker* to the frame of the Desktop Monitor or Laptop Display.
Depth:	Horizontal Distance [in mm] from the screen to the front edge of *RED250mobile Eye Tracker* at the

	center point. This center point can be located using the Setup Guide. See Measurement Settings
Height:	Vertical Distance [in mm] from the upper edge of the lower section of the screen frame to the top side of the *RED250mobile Eye Tracker* at the center point. This center point can be located using the Setup Guide. See Measurement Settings
Screen Width:	Width of the screen [in mm], not including the frame.
Screen Height:	Height of the screen [in mm], not including the frame.
RED Angle [degree]:	Angle of the Mounting Bracket that is used to connect the *RED250mobile Eye Tracker* to the Desktop Monitor or Laptop Display. Selections include 15°, 20° and 25°. Ensure you select the correct value.

See Setting Geometry Measurements.

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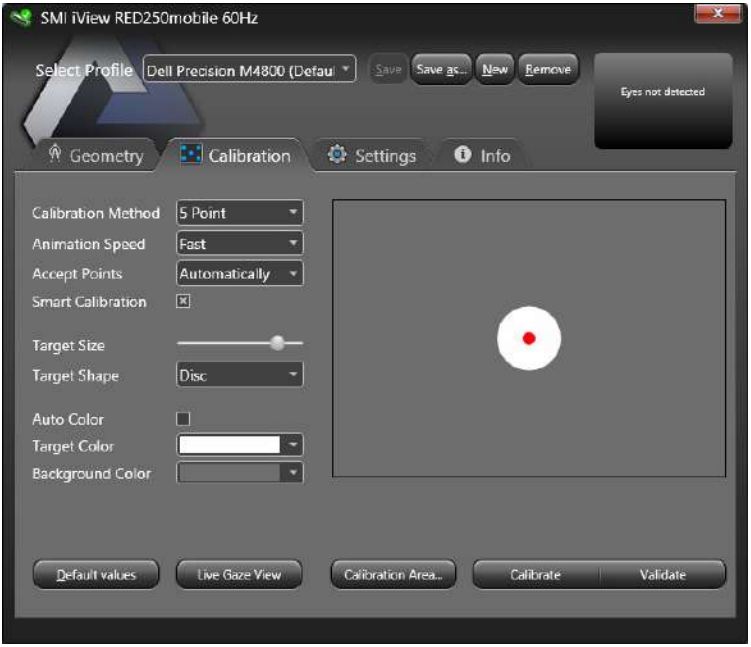
3.2 Calibration Tab

The **Calibration** tab is used to trigger the calibration process during which *iViewRED*'s internal eye model is adapted to the participant's unique eye characteristics. It is also used to perform an independent validation of the calibration results. You can furthermore configure the calibration point settings on this tab and display **Live Gaze View**.



Calibration tab

Tab Options:

Calibration Method:	Select from **0**, **1**, **2**, **5**, **9** or **13 Point**. This sets the number of points that the participant must observe during calibration.
Animation Speed:	Select from **Normal** or **Fast**. This is the speed of the animation between calibration points.
Accept Points:	Select from **Automatically**, **Semi-Automatically** or **Manually:** **Automatically**: Calibration points are displayed sequentially without requiring confirmation by the operator or participant. **Semi-Automatically**: The first calibration point needs to be confirmed by the operator or participant manually by pressing the Space Bar. **Manually**: Each calibration point needs to be accepted manually by the operator or participant by pressing Space Bar.
Smart Calibration:	Smart Calibration is checked by default in *iViewRED*. See also *Smart Calibration* in the Glossary.
Target Size:	Sets the size of the calibration target on the **Calibration** screen.

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Target Shape:	Select from **Image** or **Disc:** When **Disc** is selected, the **Target Color** option appears. When **Image** is selected, the **Target File** option appears to select an image from the PC or network drive. You can adjust the image for different use cases, for example, using engaging and captivating drawings for infant experiments.
Target Color:	Appears when **Target Shape** is set to **Circle**. Opens an **Available Colors** popup window to select from a range of grayscale colors. **This is only adjustable if you disable Auto Color function.**
Target File:	Appears when **Target Shape** is set to **Image**. Browse to an image to use as a calibration point.
Auto Color:	When selected, an average gray level of the current screen content is used as the background color of the Calibration screen.
Background Color:	Select from a set of grayscale colors for the background of the Calibration screen. Default is gray. **This is only adjustable if you disable Auto Color function.**
Calibration Results:	Displays the results of the Calibration and the optional

	Validation. It shows for each eye the ratio of accepted calibration points to the number of points. It also shows accuracy values that indicate the deviation between target points and estimated gaze position. When **Smart Tracking Mode** is used, the calibration results indicate if either or both of the eyes have been selected for tracking based on the calibration data.
Default Values:	Resets the **Calibration** tab to original settings.
Live Gaze View:	When clicked, the screen is dimmed with the exception of a moving bright area, which corresponds to the movement of the participant's gaze. Live Gaze View mode can be ended by pressing the **Live Gaze View** button again or by pressing the ESC key. This feature is available only after a calibration has been performed successfully.
Calibration Area:	**This settings is for Advanced Users only. Changes are not normally required to these settings.** After clicking the button, the **Calibration Area** will be shown in full screen mode. You can then change the location of each calibration point separately.
Calibrate:	Starts the calibration.

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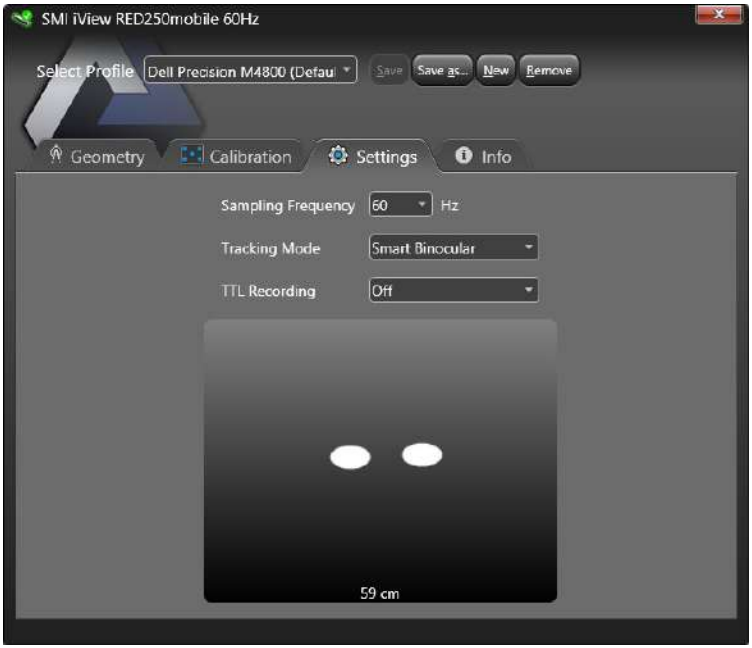
Validate:	Starts the validation. This is done after the calibration has been run.

3.3 Settings Tab

The **Settings** tab displays the **Eye Tracking Monitor** and settings for the **Sampling Frequency, Tracking Mode and TTL Recording**. Eye Images can also be displayed.



Settings tab

Tab Options:

Sampling Frequency:	Select from **60**, **120** or **250** Hz sampling rate.
Tracking Mode:	Select from **Smart Binocular, Monocular Left, Monocular Right** and **Smart Tracking**.

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Show Tracking:	Displays the **Eye Tracking Monitor** in a larger size for easy viewing. Checked by default
Show Eye Images:	Hidden by default. The eye images can be displayed by right-clicking on the **Eye Tracking Monitor**.

See Setting Tracking Mode and Showing Eye Images.

3.4 Info Tab

The **Info** tab shows the system information. You can also check for software updates (Internet access required), launch the Online Help, and contact SMI for support requests (Internet access required).

Info tab

Tab Options:

System Information:	Lists the key operating parameters of the system. This information can be copied to the Clipboard for pasting into an email.
Check for updates:	Sends a request to the SMI Updates server for the latest software updates (Internet access

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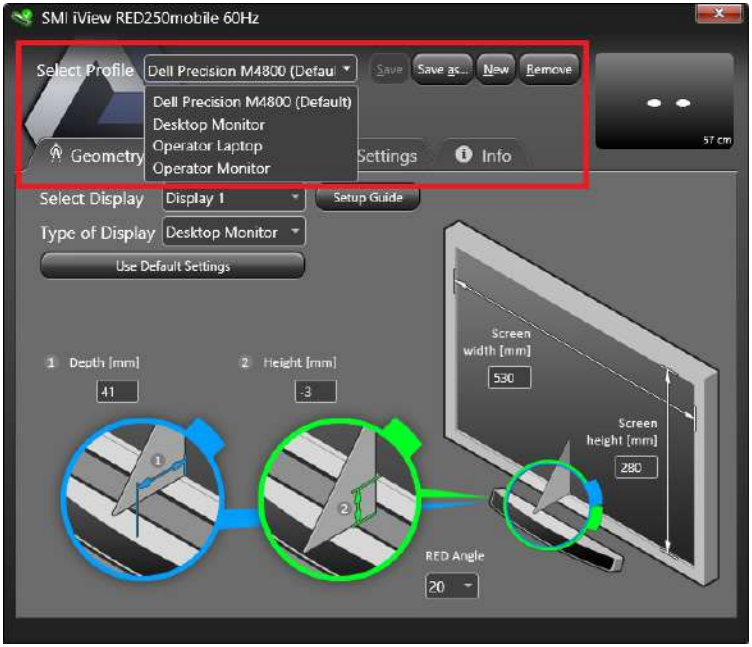
	required). If a new version is available, it will be installed.
Open User Manual:	Launches Online Help.
Contact SMI:	Use to send an email to SMI for support requests. It launches the default email application (Internet access required).

See Checking for Software Updates.

3.5 Profile Selector

Settings made for a specific system or experiment can be saved to a profile. This can be useful when studies are run sometimes with a Laptop Display and sometimes with a Desktop Monitor. Profiles are also useful when different tracking and calibration settings are used in different experiments. In this way you can always use the same profile, and therefore the same settings, for the same experiments.



Select Profile Area

Profiles cannot be used across different PCs or Laptops.

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Select Profile Options:

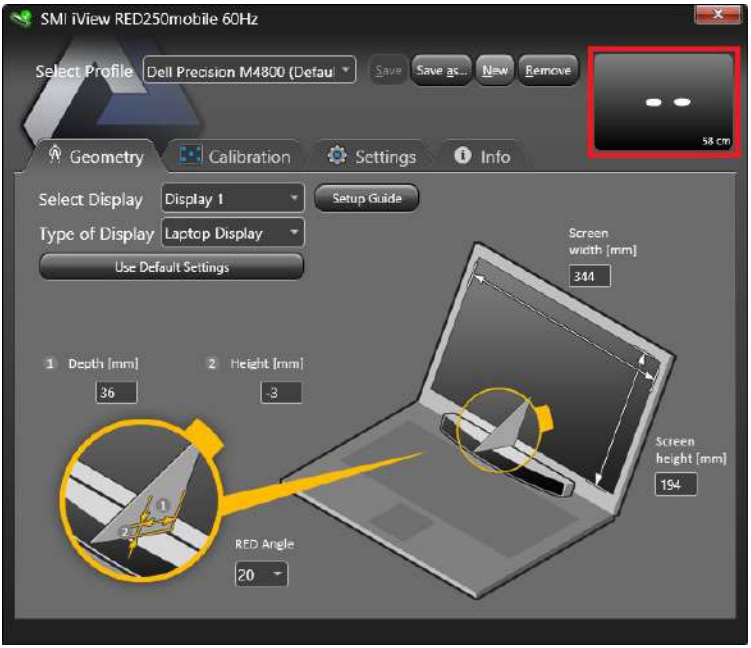
Select Profile:	A profile includes all the defined settings made in all the tabs. If two or more profiles have been created, you can select a specific profile from the dropdown list.
Save:	After making changes to any of the settings, you can save these settings to the currently selected profile.
Save as:	After making changes to any of the settings, you can save these settings to a new profile.
Add:	You can create a new profile, which will save any settings made to this new profile.
Remove:	If you do not need a profile, you can remove it. All settings saved to this profile will be lost.

Profiles which are marked with a * behind the name contain unsaved profile changes.

See Managing Profiles.

3.6 Eye Tracking Monitor

The **Eye Tracking Monitor** helps the operator to find the optimum position for the participant to sit in front of the *RED250mobile Eye Tracker*. Before running a calibration or an experiment, it is strongly recommended that the participant is sitting in this optimum position.



Eye Tracking Monitor

A larger Eye Tracking Monitor is provided on the **Settings** tab.

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Features:

Arrows:	When the participant is not sitting in an optimum position, arrows are shown to guide the participant. These include move left, move right, move closer to the screen, move away from the screen.
Distance Values:	A distance value is also displayed to indicate how near (or far) a participant is from the *RED250mobile Eye Tracker*.

See Positioning the Participant.

3.7 Status Indicators

The operating status of the *iViewRED* software is indicated through the use of icons in the Windows ™ Taskbar and in the software's title bar.

Status Indicators:

Not Connected: Indicates the *RED250mobile Eye Tracker* has not connected with the *iViewRED* software. This can be due to the USB cable on the Eye Tracker not connected with the USB port or the software has lost connection with the Eye Tracker. Check connections and/or restart *iViewRED*.

Connecting: Indicates *iViewRED* is attempting to establish a connection with the *RED250mobile Eye Tracker* via USB.

Running: Indicates the *iViewRED* has established a connection with the *RED250mobile Eye Tracker*.

See Running iViewRED.

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Getting Started

Chapter

4

4. Getting Started

Follow these steps to get started using the RED250mobile System. Detailed instructions are provided in later sections of this User Guide.

1. Preparation:

a. Download and run the *iViewRED* Installation Package, which is available at www.smivision.com/software/.

b. After *iViewRED* has been installed, run the application.

c. Connect the *RED250mobile Eye Tracker* to an available USB port on the PC or Laptop.

The *RED250mobile Eye Tracker* requires a USB 2.0 port.

d. The **Geometry** tab will be displayed in *iViewRED*.

e. On the **Geometry** tab, select the type of display used from the **Display Type** dropdown menu. Select **Laptop Display** or **Desktop Monitor**.

f. On the **Geometry** tab, click **Setup Guide**. This will display a vertical line on the screen in the exact horizontal center of the selected screen. It is used to correctly mount the *RED250mobile Eye Tracker* on a Laptop Display or Desktop Monitor.

2. Mount the *RED250mobile Eye Tracker*:

a. Select a Mounting Bracket from the available Mounting Brackets. The 20° Mounting Bracket is provided as standard. A 15° and 25° Mounting Bracket are available from SMI.

b. Insert the Mounting Strip into the Mounting Bracket.

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c. Remove the protective cover from the Mounting Strip.

d. Horizontally align the Mounting Bracket with the vertical Setup Guide displayed on the screen. You can use the Reference Point on the Mounting Bracket (the Reference Point is a small indentation on the top side of the Mounting Bracket) for alignment.

e. Vertically align the top of the Mounting Bracket **exactly** with the upper edge of the lower frame of the screen.

Ensure the Mounting Bracket is right side up before attaching. The Reference Point is on the top side of the Mounting Bracket and the Mounting Bracket is angled upwards.

f. Press and hold the Mounting Bracket against the frame for a few moments to ensure adhesion.

Once the Mounting Strip has been attached, it cannot be easily removed. Ensure that the device has been attached in the correct position.

g. Connect the *RED250mobile Eye Tracker* to the Mounting Bracket using the magnetic slots.

The USB cable connector should be on the right side of the device and the Reference Point on the Mounting Bracket should be facing upwards.

3. Set Geometry Measurements:

a. If a second Display or Monitor is connected to the Desktop PC or Laptop, click the **1-2** button on the **Geometry** tab to show the Display 1 and Display 2 identifiers. Select from the **Select Display** dropdown menu the Display or Monitor on which the *RED250mobile Eye Tracker* is mounted.

b. Click **Use Default Settings** to obtain measurements for **Screen Width** and **Screen Height.** If the *RED250mobile Eye Tracker* is mounted to the SMI-supplied laptop, and mounting instructions were followed precisely, the **Depth** and **Height** measures for *RED250mobile Eye Tracker* positioning are given by the default values. Select the angle of the Mounting Bracket.

If top of the Mounting Bracket could not be aligned to the upper edge of the lower frame of the Display or if a Display other than that of the SMI-supplied Laptop is used, then you will have to manually enter the geometry measurements.

4. Position the Participant

a. Ensure the participant is sitting in an optimal position. See Positioning the Participant

b. Use the **Eye Tracking Monitor** to position the participant in the center of the Head Box.

5. Perform Calibration:

a. On the **Calibration** tab, set the calibration method, speed and other options as required.

b. Perform a Calibration.

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Performing a Validation is optional.

6. Create a Profile:

a. Save your default Geometry and Calibration settings for easy recovery for future experiments.

b. Either add the changes to the existing profile by clicking the **Save** button or create a new profile to save these settings by clicking **New**.

7. The *RED250mobile Eye Tracker* is ready.

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Installing iViewRED Software

Chapter

5. Installing iViewRED Software

The Installation Package for *iViewRED* software is available as a free download on the **Software Downloads** area of the SMI website. This Installation Package also includes the required drivers.

If the *RED250mobile Eye Tracker* has been shipped with the SMI Laptop, then all required software is already installed. You should, however check for software updates. See Checking for Software Updates.

5.1 Obtaining the Installation Package

To obtain the *iViewRED* software Installation Package:

1. Go to the **Software Downloads** area of the SMI website at www.smivision.com/software/.

2. Click the download link for the *iViewRED* Installer *SMI iViewRED.msi*.

3. On the **File Download** dialog, click **Save File** to download the installer to your PC or Laptop.

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5.2 Installing the Required Software

Before installing *iViewRED*, ensure the *RED250mobile Eye Tracker* is disconnected from the Laptop or PC.

To install the required software:

1. Run the *iViewRED* Installer *SMI iViewRED.msi*.

2. When the **Prerequisites Installer** dialog appears, click **Install** to begin.

The **Prerequisites Installer** lists the software required to run *iViewRED*, which includes the .NET Framework 4.0 Client. If the .NET Framework is already installed, only the *iViewRED* Installer will be shown.

3. If the .NET Framework 4.0 Client needs to be installed, you will be asked to confirm the installation of this software. An Installation Wizard will then download from Microsoft the .NET Framework 4.0 Client. Depending on the internet connection speed, this may take a few minutes.

    a. In the **.NET Framework Setup** dialog, accept the terms and conditions and click **Install** to continue.

    b. The .NET Framework 4.0 Client will be installed.

    c. Click **Finish** to complete the installation.

4. The **iViewRED Setup Wizard** will appear. Click **Next**.

5. Accept the **License Agreement** and click **Install**.

6. *iViewRED* will now be installed.

7. Click **Finish** to dismiss the dialog.

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Running iViewRED

Chapter

6

6. Running iViewRED

If the *RED250mobile Eye Tracker* has not yet been mounted, see Mounting the Eye Tracker.

To run *iViewRED*:

1. Attach the *RED250mobile Eye Tracker* to the Mounting Bracket, which is attached to the Laptop Display or Desktop Monitor.

2. Connect the *RED250mobile Eye Tracker* to a USB 2.0 port on your Laptop or Desktop PC.

3. Start *iViewRED*.

4. The **Startup** screen will appear and *iViewRED* will immediately begin attempting to connect to the *RED250mobile Eye Tracker*.

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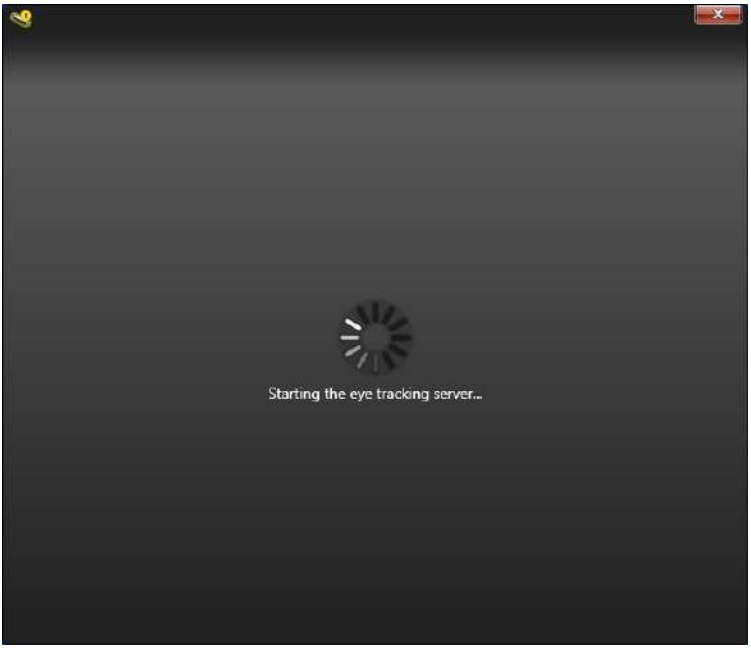
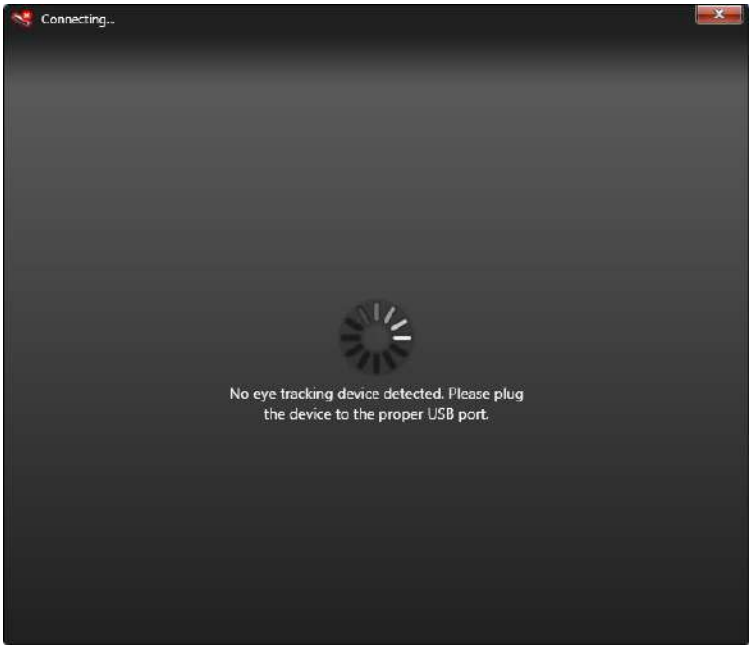


Startup screen

5. When connected, a set of LEDs on the front panel of the *RED250mobile Eye Tracker* will be illuminated. This indicates the cameras are switched on and is sending data.

If *iViewRED* could not connect to the *RED250mobile Eye Tracker* a status message will appear: **No device detected. Please make sure the device is plugged in**. The status indicator will change to **Not Connected**. In this case, ensure the device is properly connected to a USB 2.0 port. See Troubleshooting.



Could not connect to Eye Tracker

6. When connected, the default screen of *iViewRED* will appear showing the **Geometry** tab and the status indicator will change to **Running**.

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Mounting the Eye Tracker

Chapter

7

7. Mounting the Eye Tracker

Mounting the *RED250mobile Eye Tracker* is simple and takes only a few minutes. It is designed to be mounted on the lower frame of a Desktop Monitor or Laptop Display.

7.1 Mounting Guides

Mounting guides have been provided to assist you in mounting the device.

- **Reference Point** - This physical mark on the Mounting Bracket is located at the exact center of the bracket for alignment with the Setup Guide.

Reference Point

- **Setup Guide** - This is a vertical line displayed at the exact vertical center of the screen for alignment with the Reference Point on the Mounting Bracket. It is displayed by clicking **Setup Guide** on the **Geometry** tab of *iViewRED*.

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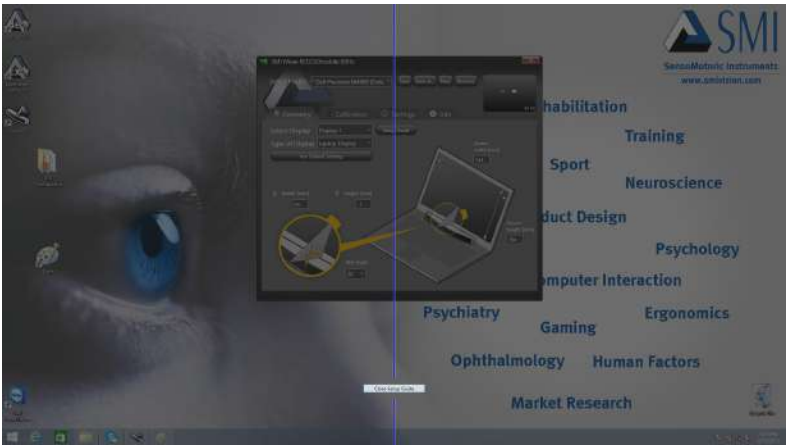


Setup Guide

7.2 Mounting Instructions

The mounting instructions provided in this section are relevant to both Laptop Displays or Desktop Monitors.

Before proceeding, ensure *iViewRED* has been installed. If not see Installing iViewRED Software.

To mount the *RED250mobile Eye Tracker* on a Laptop Display or a Desktop Monitor follow these steps:

1. **Connect the *RED250mobile Eye Tracker* to a USB 2.0 port.**

   a. Locate an available USB 2.0 port

   b. Connect the USB cable of the *RED250mobile Eye Tracker* to the USB 2.0 port.

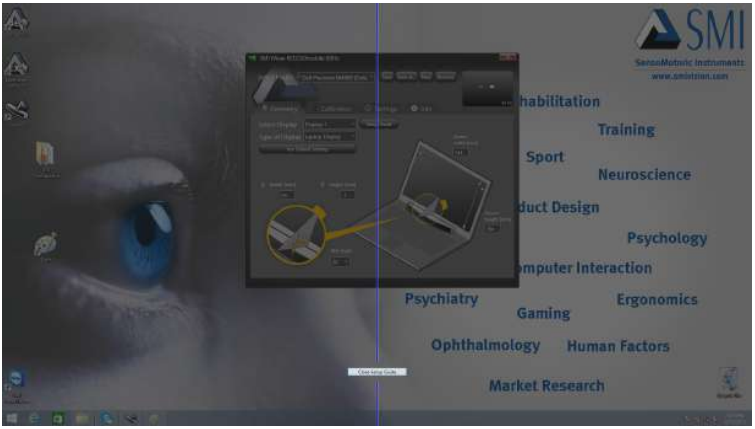
   c. Start *iViewRED*.

d. *iViewRED* will attempt to connect to the *RED250mobile Eye Tracker*.

e. Once connected, the LEDs on the *RED250mobile Eye Tracker* will illuminate.

2. Attach the Mounting Bracket to the Laptop Display or Desktop Monitor.

a. With *iViewRED* running, click Setup Guide on the Geometry tab to display the vertical Setup Guide. This blue line is displayed at the exact vertical center of the screen.



Setup Guide

b. Connect the magnetic Mounting Strip to the back of the Mounting Bracket.

c. Remove the protective cover from the Mounting Strip.

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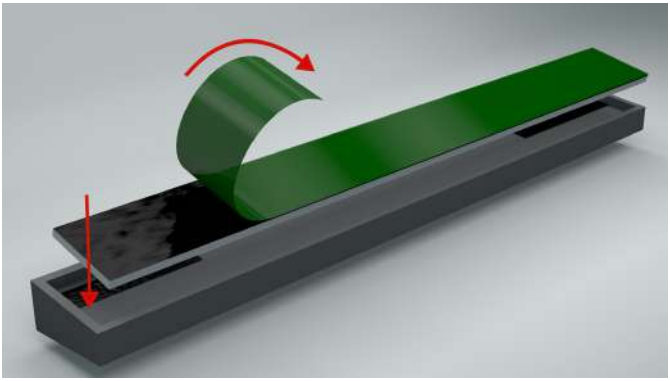

Prepare the Mounting Bracket

d. Horizontally align the Mounting Bracket: Using the Reference Point on the Mounting Bracket, carefully align the Mounting Bracket to the vertical **Setup Guide** displayed on the screen. Ensure that the Reference Point is facing upwards.

e. Vertically align the Mounting Bracket: Carefully align the top of the Mounting Bracket to the upper edge of the bottom frame of the screen.

f. Firmly press and hold the Mounting Bracket to the frame at that position for a few moments to ensure adhesion.

g. Your setup should look like this.

Mounting Bracket correctly attached to the screen frame. The Reference Point on the Mounting Bracket should align with the Setup Guide.

3. Connect the *RED250mobile Eye Tracker* to the Mounting Bracket.

a. The *RED250mobile Eye Tracker* can only be connected to the Mounting Bracket in one direction. This ensures the cameras on the device are in the correct orientation and that the USB cable is on the right side of the device.

Attach the eye tracker to the Mounting Bracket.

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b. Attach the *RED250mobile Eye Tracker* to the Mounting Bracket using the magnet connectors.

For important information about the magnets, see Precautions.

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Managing Profiles

Chapter

8

8. Managing Profiles

A profile stores all the values set in iViewRED. A default profile is provided which contains the most commonly used settings. You can save changes to this default profile or you can create a unique profile that saves settings made for specific conditions or participants. You can then easily switch between profiles without having to re-enter these settings.

8.1 Creating and Modify Profiles

Create a Profile

To create a profile:

1. In the **Select Profile** area, click **New** to open the **Creating a new profile** dialog.

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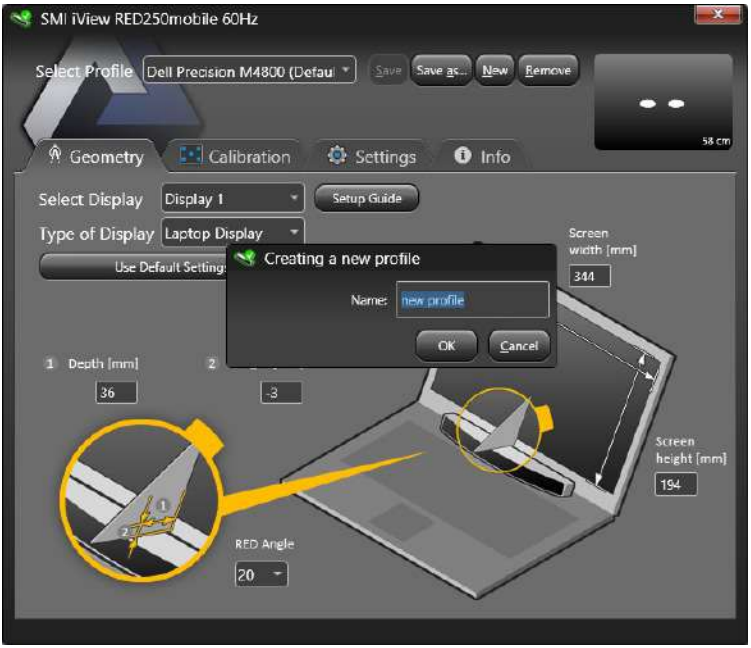


Add new profile

2. Enter a profile name in the **Name** field, and click **OK**.

3. Any settings made can be saved to this profile by clicking **Save**.

Modify a Profile

To modify some settings of an existing profile you can use the option **Save as... .** All current profile settings will be copied to a new profile. Please refer to the following steps:

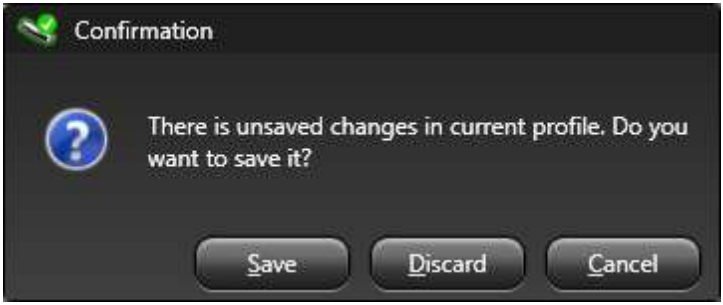
1. Select the profile you want to modify and make all changes you want to submit..

2. Click on the **Save as...** button in the **Select Profile** area. A new window called **Saving profile as...** appears.

3. Enter a new profile name in the **Name** field and click **OK**.

Profiles which are marked with a * behind the name contain unsaved profile changes. If you want to keep the changed settings, please use the **Save** button in the **Select Profile** area.

If you create a new profile or close the application and the current selected profile contains unsaved changes, you have to confirm if you want to save or discard these changes. A **Confirmation** dialog will appear when ever there are changes to the profile which are not saved.



8.2 Selecting Profiles

To select a profile:

1. From the **Select Profile** field, click the down-arrow to open a list of available saved profiles.

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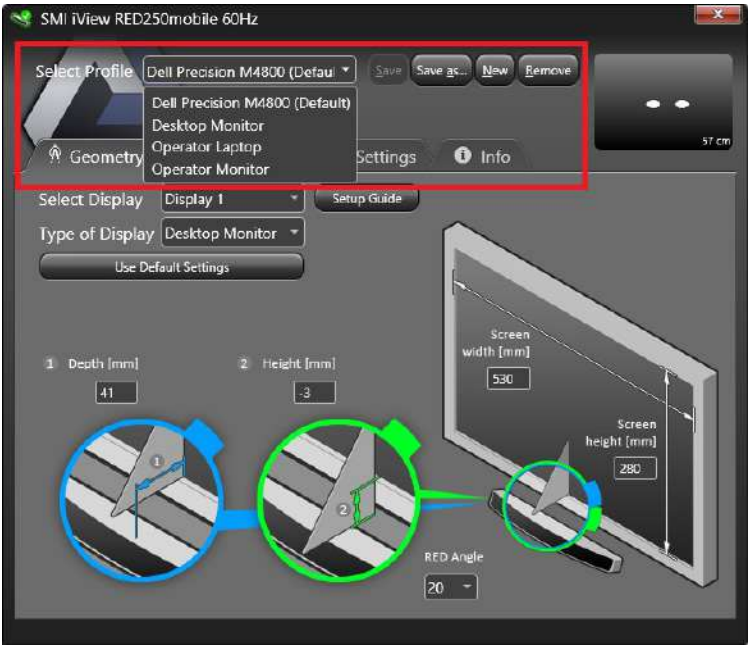

Select profile

2. Select one of the saved profiles.

3. The settings stored in the selected profile will be automatically loaded into the application.

8.3 Deleting Profiles

Profiles no longer needed can be deleted.

When a profile is deleted, the settings saved in the profile will be lost.

To delete a profile:

1. In the **Select Profile** field, click the down-arrow to open a list of available saved profiles.

2. Select a saved profile from the list and click **Remove**.

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Setting Geometry Measurements

Chapter

9

9. Setting Geometry Measurements

The **Geometry** tab is used to set geometry measurement that provide to *iViewRED* the actual position of the *RED250mobile Eye Tracker* mounted on the Stimulus Display. These settings are important for optimal mapping of the eye tracking data to the Stimulus Display.

9.1 Using Multiple Displays

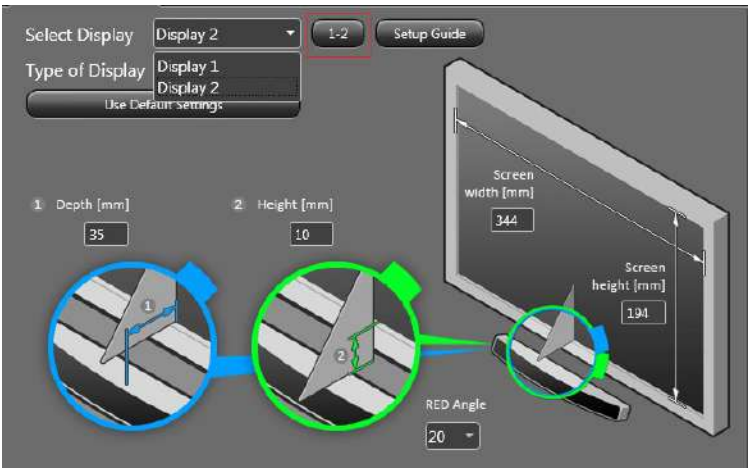
If a second monitor is attached to your Desktop PC or Laptop, you must select which of the two displays will be used by the *RED250mobile Eye Tracker*.

To select the display used by the **RED250mobile Eye Tracker**:

1. Run *iViewRED*.

2. Select the **Geometry** tab.

3. The **Select Display** dropdown menu will show **Display 1** and **Display 2** and the **1-2** button will appear.



1-2 Button to show display identifiers

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4. Click the **1-2** button to show the Display Identifiers. In the following example, *iViewRED* is shown on Display 1, which can be used by the operator. The *RED250mobile Eye Tracker* is mounted on Display 2 which is used by the participant.

Two displays overlayed with labels

5. Choose from the **Select Display** dropdown list the display on which the *RED250mobile Eye Tracker* is mounted. In this example, you would select **Display 2**.

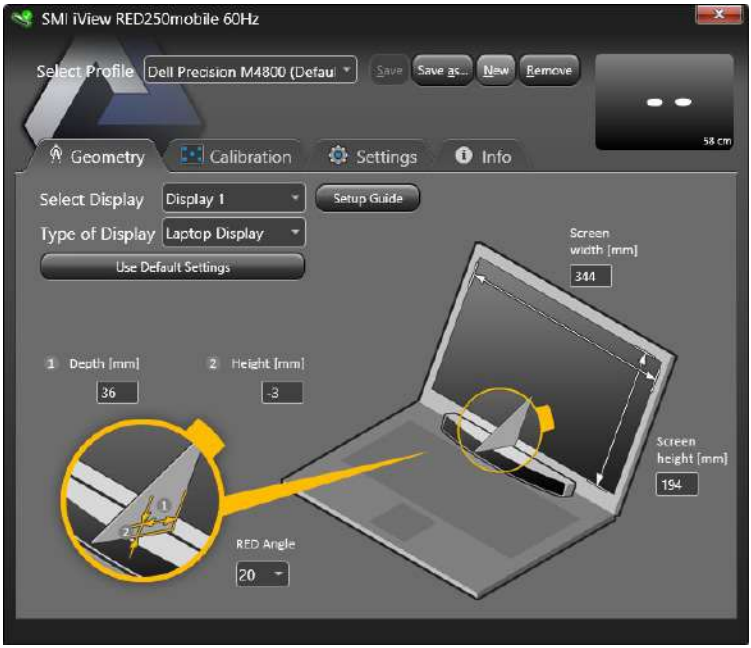
9.2 Selecting Type of Display

The **Geometry** tab provides a set of fields for entering geometry measurements for Laptop Displays or Desktop Monitors used with the *RED250mobile Eye Tracker*. Therefore, before you enter those measurements, you need to select the type of display.

To select the type of display:

- Select **Laptop Display** or **Desktop Monitor** from the **Type of Display** dropdown menu:

The following shows the **Laptop Display** settings.



Geometry tab for Laptop Display Settings

The following shows the **Desktop Monitor** settings.

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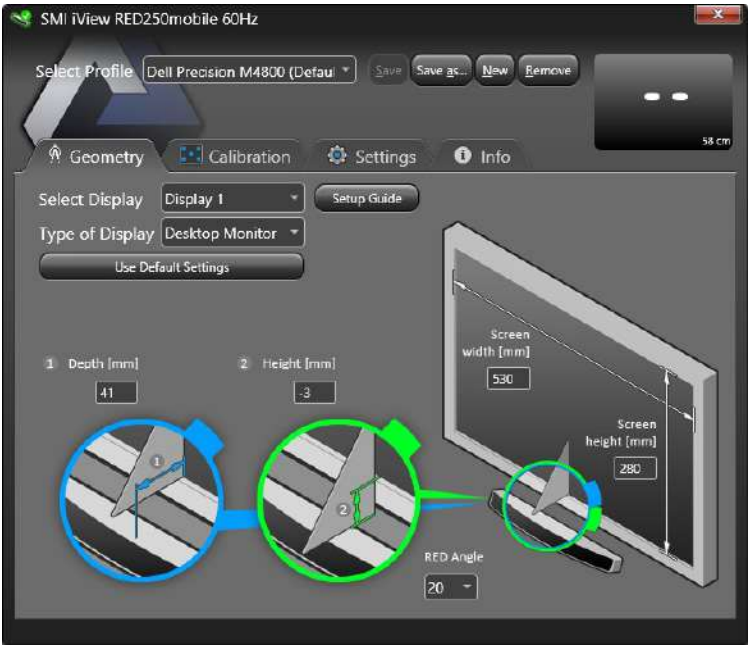


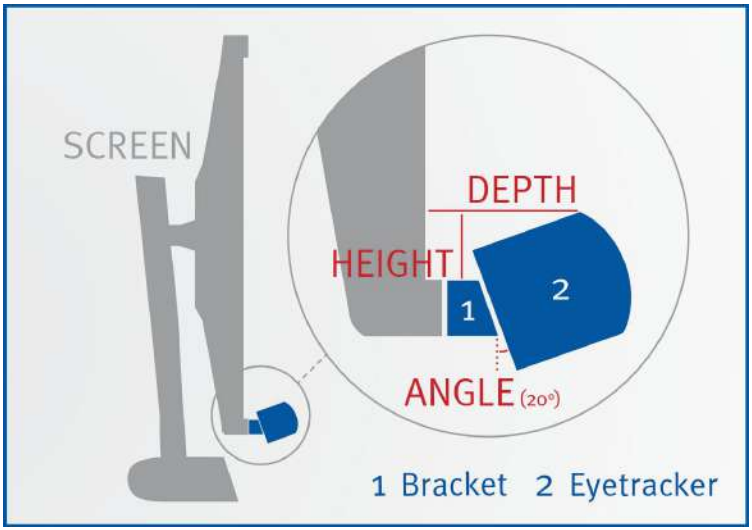
Geometry tab for Desktop Monitor Settings

9.3 Required Measurement Values

A set of measurement values are required by *iViewRED* for the software to know the actual position of the *RED250mobile Eye Tracker*. These values provide an optimal mapping of the eye tracking data to the stimulus display. This can be done manually or assisted automatically.

See Automatically Detecting Measurement Settings and Manually Entering Measurement Settings.

The following provides a general illustration of the measurements required by *iViewRED*.



Measurements required by iView RED. THe angle is defined by the Mounting Bracket utilized.

9.4 Automatically Detecting Measurement Settings

iViewRED provides an automatic detection of screen measurement settings. This is done through the **Use Default Settings** button on the **Geometry** tab.

Automatic detection of **Screen Width** and **Height** works for the vast majority of monitors on a single PC setup.

However, **Depth** and **Height** values as provided with the **Use Default Settings** function are the default positioning values of the *RED250mobile Eye Tracker* on the SMI-supplied Laptop if mounting instructions have been followed precisely. When using a different monitor or laptop, or adjustments to the default mounting were made, these settings should be manually adjusted.

Using Automatic Detection

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To automatically detect measurement settings:

1. On the **Geometry** tab, select the type of display from the **Select Display** dropdown.

2. If you have not done so already, create a new profile, such as "Experiment Laptop". See Creating Profiles.

3. If a second display is connected to the PC or Laptop, use the **1-2** button and select from the **Select Display** dropdown the display that will be used with the *RED250mobile Eye Tracker*. See Using Multiple Displays.

4. Click **Use Default Settings**.

5. *iViewRED* will detect the measurement values and load these values into the fields.

6. Select from **15**, **20** or **25** to enter the angle value of the Mounting Bracket into the **RED Angle [Degree]** field. See Setting RED Angle.

Use Default Settings works on most systems. Some systems may be incompatible with Windows™ standard interfaces. In this case, a manual check and correction of the settings is recommended.

9.5 Manually Entering Measurement Settings

When to Manually Enter Measurement Settings

In cases where it is not advisable to use automatically detected measurement settings, you will need to manually determine and enter these measurement settings into *iViewRED*. This cases include:

- The *RED250mobile Eye Tracker* could not be aligned correctly with the upper edge of the lower frame of the Display screen.
- The frame thickness of your Display's frame is different from the thickness of the SMI provided Laptop's Display frame.
- You are using a Dual PC setup or a Display for which screen parameters cannot be detected.

For a description of the measurement values, see Required Measurement Values.

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Using Manual Settings

To manually enter the measurement settings:

1. On the **Geometry** tab, select the type of display from the **Select Display** dropdown.

2. If you have not done so already, create a new profile, such as "Experiment Laptop". See Creating Profiles.

3. If a second display is connected to the PC or Laptop, use the **1-2** button and select from the **Select Display** dropdown display that will be used with the *RED250mobile Eye Tracker*. See Using Multiple Displays.

4. Determine the **Depth** measurement and enter the measurement in the **Depth [mm]** field. See Setting Depth and Height.

5. Determine the **Height** measurement and enter the measurement in the **Height [mm]** field. See Setting Depth and Height.

6. Determine the **Screen Width** and **Height** measurements and enter these measurements in the **Screen Width [mm]** and **Screen Height [mm]** fields. See Setting Screen Width and Height.

7. Select from **15**, **20** or **25** to enter the angle value of the Mounting Bracket into the **RED Angle [Degree]** field. See Setting RED Angle.

9.6 Setting Depth and Height

Obtaining the Depth Measurement

To obtain the depth measurement:

1. Run *iViewRED* and click **Setup Guide** on the **Geometry** tab.

2. Place the Triangle against the screen along the Setup Guide and on top of the *RED250mobile Eye Tracker*.

3. Measure the depth from the screen to the front corner of the *RED250mobile Eye Tracker*. The **Depth** measurement in this example is approximately 22 mm.

Depth measurement

4. Enter the **Depth** measurement in the **Geometry** tab.

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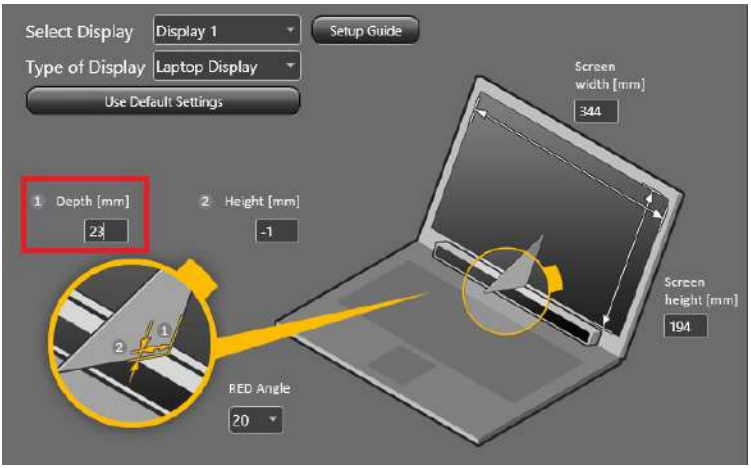


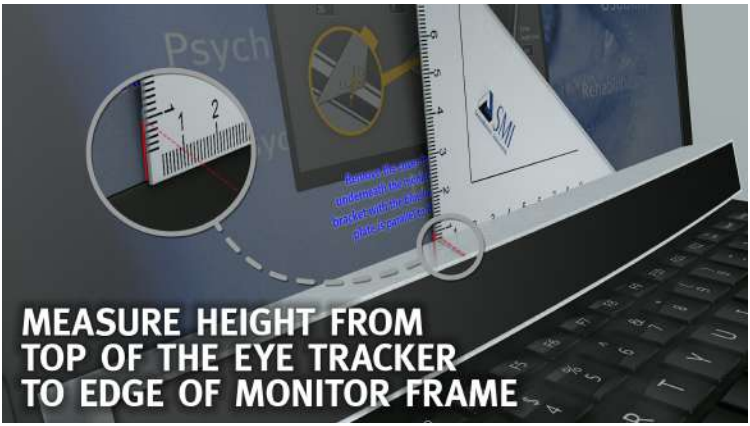
Depth [mm] field

Obtaining the Height Measurement

To obtain the height measurement:

1. Run *iViewRED* and click **Setup Guide** on the **Geometry** tab.

2. Place the Triangle as shown in the following image. The Triangle is placed on top of the display lower frame at the screen and aligned to the vertical line displayed by the **Setup Guide**. The distance you want to obtain is the height from the Triangle to the front top of the *RED250mobile Eye Tracker*.



Negative height offset

3. Enter the **Height** measurement in the **Geometry** tab.

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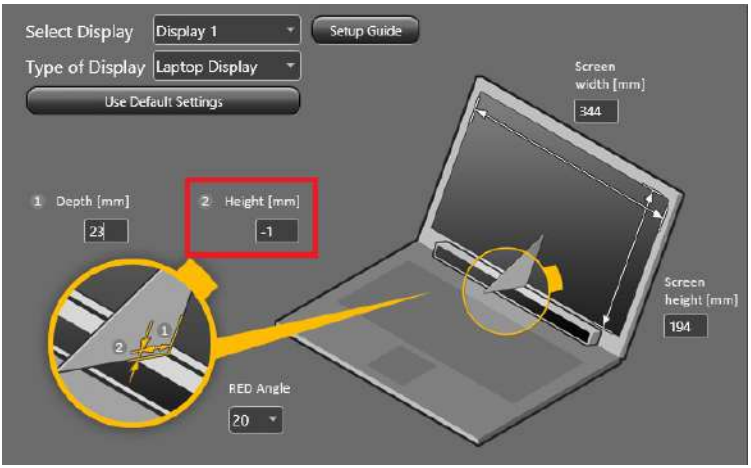
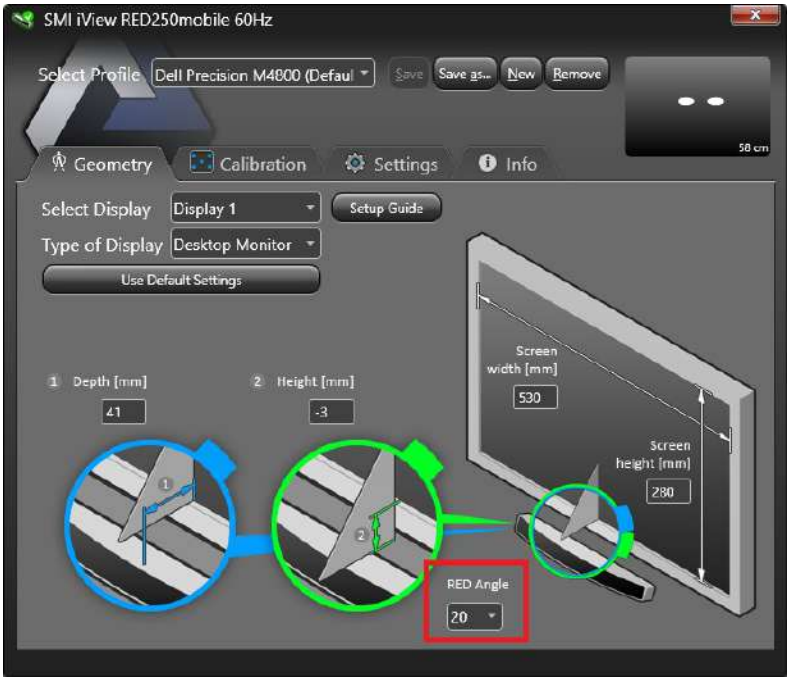


Height [mm] field

9.7 Setting RED Angle

The RED angle is determined by the angle of the Mounting Bracket used to connect the *RED250mobile Eye Tracker* to the Desktop Monitor or Laptop Display.

- Select from the **RED Angle** dropdown menu **15**, **20** or **25**.



The standard Mounting Bracket supplied is the 20° bracket. Other Mounting Brackets available from SMI include a 15° Mounting Bracket and a 25° Mounting Bracket.

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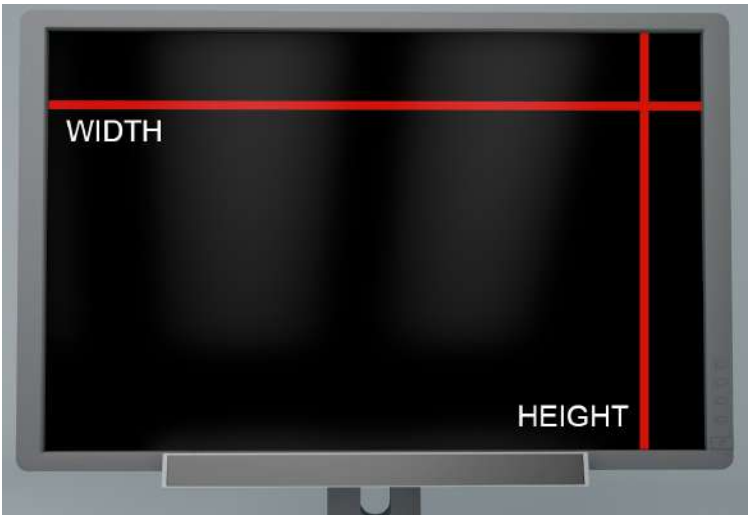
9.8 Setting Screen Width and Height

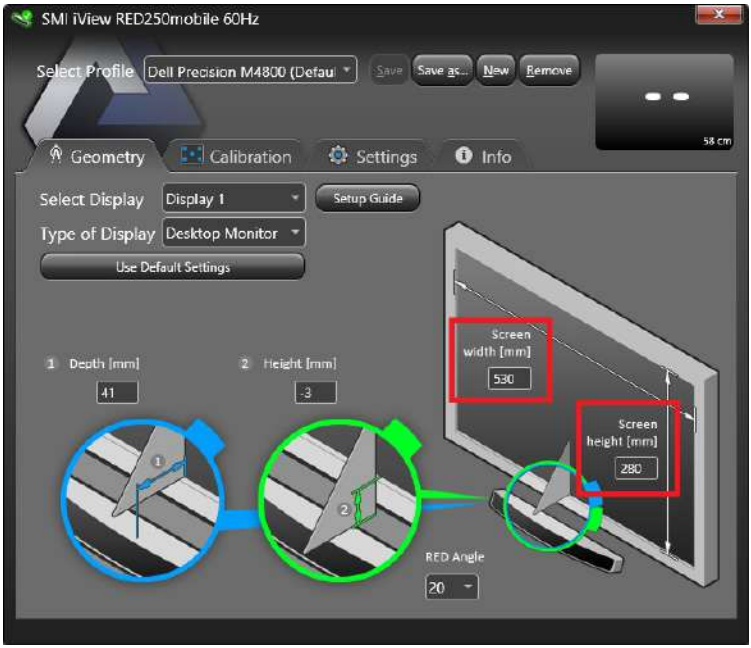
These two measurements are the dimensions of the display area of the screen as illustrated below.



Screen Height and Width measurements

You can use **Use Default Settings** to obtain the screen width and height. This works for most displays in a single PC setup.

These values are entered in the **Geometry** tab.



Interface to set Screen Height and Width

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Positioning the Participant

Chapter

10

10. Positioning the Participant

Before running a calibration, the operator needs to assist the participant to find a sitting position that is comfortable and yet allows the participant to be tracked by the *RED250mobile Eye Tracker*. *iViewRED* helps the operator to find that position through the use of an **Eye Tracking Monitor** .

10.1 Optimal Participant Position

Here are some recommendations for locating the optimal participant position:

- Ensure the participant is sitting comfortably.
- Ensure the participant is sitting approximately centered in front of the *RED250mobile Eye Tracker* and directly facing the screen. This location can be found using the **Eye Tracking Monitor**.
- Ensure the participant is positioned at a distance away from the screen that is roughly in the center of the operating distance of the *RED250mobile Eye Tracker*. This distance can be found using the **Eye Tracking Monitor**.

See also Optimal Conditions

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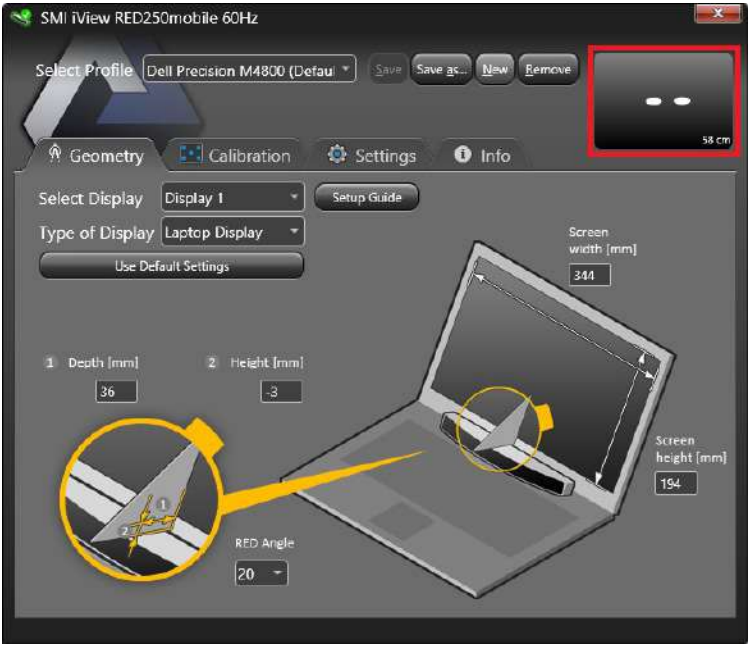
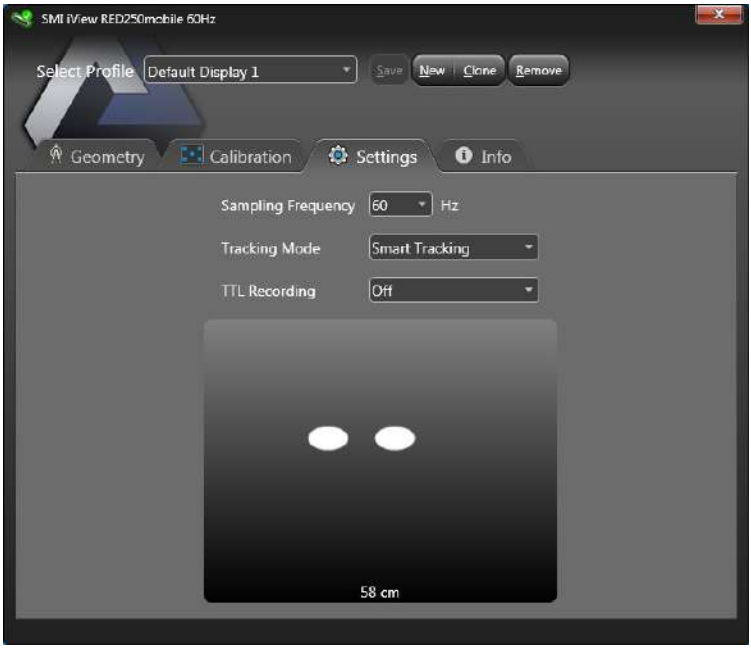
10.2 Eye Tracking Monitor

The **Eye Tracking Monitor** is located in the upper area of *iViewRED*.



Eye Tracking Monitor

The **Settings** tab provides a larger Eye Tracking Monitor, when **Show Tracking** is selected.



Eye Tracking Monitor on the Settings tab

Distance Measurement

To indicate how far (or near) a participant is from the *RED250mobile Eye Tracker*, the **Eye Tracking Monitor** provides a distance measurement at all times. In the example below, the participant is 52 cm away from the screen.

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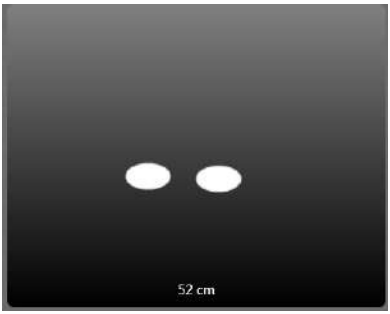


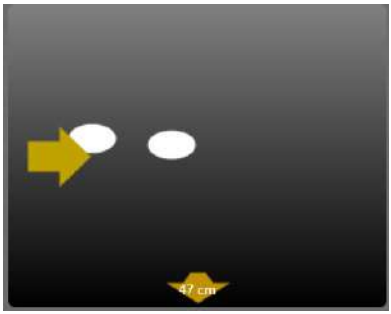
Eye Tracking Monitor - Distance

Eye Tracking Monitor Arrows

When a participant is within the optimum sitting position, the **Eye Tracking Monitor** will be displayed without arrows. However, when the participant begins to move towards the edges of the Head Box, the **Eye Tracking Monitor** provides arrows to assist the participant to move back towards the optimum position.

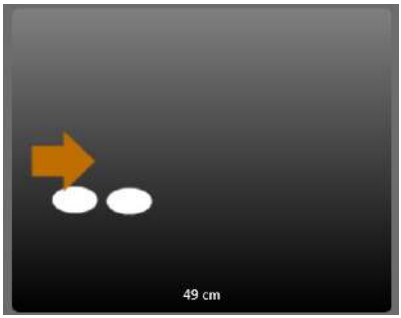
The participant can still be tracked when the arrows appear. They simply serve as guides to help position the participant to remain within the optimal location.

- **Arrow Directions** - When the participant is not sitting in an optimum position, arrows are shown to guide the participant. These include **move left**, **move right**, **move closer to the screen**, **move away from the screen**. In the example below, the participant should move to the right and away from the screen.



Eye Tracking Monitor - Arrows

- **Arrow Colors** - The color of the arrows indicate a progression from close to optimum to close to out of tracking range. These colors are Orange, Yellow, and Red:



Orange indicating close to optimum

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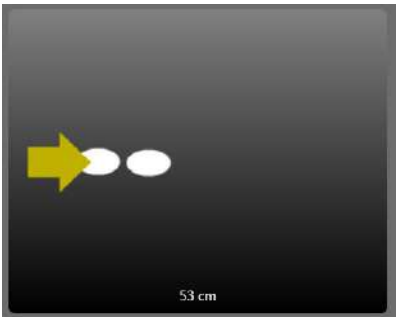
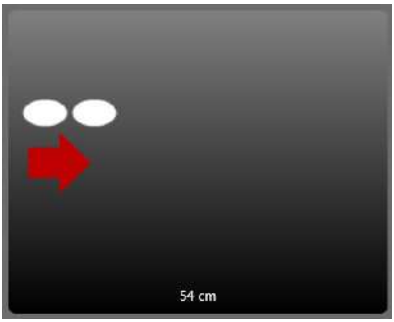


Yellow indicating moving away from optimum



Red indicating moving out of trackable range

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Performing a Calibration

Chapter

11

11. Performing a Calibration

When a calibration is performed, the participant observes a series of calibration points sequentially displayed on the screen. The calibration can then be validated (optional) using a similar procedure on independent points.

11.1 Running a Calibration

When clicking **Calibrate** in the **Calibration** tab, *iViewRED* goes briefly into full screen mode and a series of target shapes are displayed in succession in each of the areas of the screen as defined by the **Calibration Method**.

Calibration can be canceled at any time by using the **Esc** (Escape) key.

To run a calibration:

1. Ensure the measurement values of the Laptop Display or the Desktop Monitor are set in the **Geometry** tab. See Setting Geometry Measurements.

2. Select the **Calibration** tab.

3. If required, set the calibration method, calibration speed, Smart Calibration and method of accepting calibration points.

4. Click **Calibrate** to begin.

5. *iViewRED* goes into full screen mode and displays the **Calibration** screen with an initial focus point in the center of the screen.

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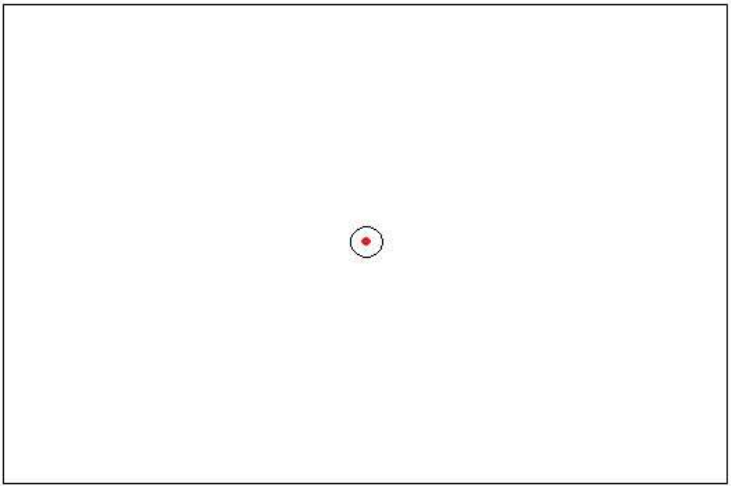
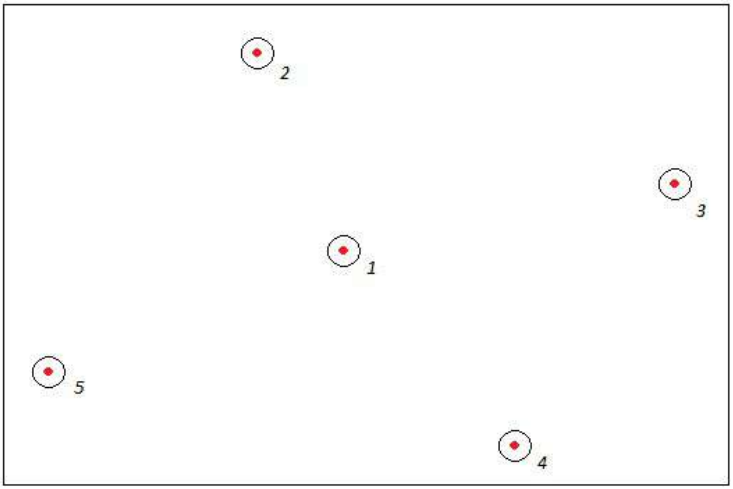


Initial focus point

6. After a few moments, and depending on the settings for **Animation Speed** and **Calibration Method**, one or more focus points will be displayed in succession on the screen. Depending on the settings for **Accept Points**, you may need to press the **Space Bar** to continue. The participant must focus on each point as it is displayed. The following shows five target points distributed across the screen.



Focus points

The participant must keep their eye gaze focused on these points. If the results are unusual or inadequate, run the calibration again while ensuring the participant keeps a focus on each point as it appears.

7. When the calibration is completed, *iViewRED* exits full screen mode and returns to the **Calibration** tab.

8. The results of the calibration are saved to the participant profile. In the **Calibration Monitor**, the results of the calibration is displayed.

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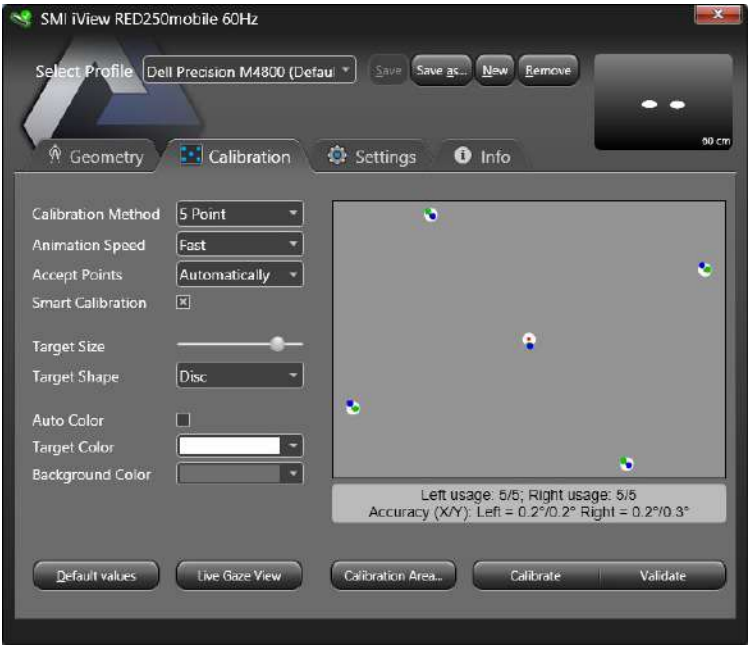

Calibration results

For an explanation of the results of the calibration, see Understanding the Results.

9. The calibration can be then validated, as described in Running a Validation.

11.2 Calibration Methods

Calibration methods with a higher number of calibration points may improve the results but require the participant to focus their attention for a longer time. The decision to use a higher or lower number of calibration points should consider how long a particular participant can concentrate and how well they can focus.

In most cases, a 5 Point calibration will provide the best trade-off between duration of calibration and results.

See also *Calibration* in the Glossary

The *RED250mobile Eye Tracker* provides six calibration methods:

- 0 Point Calibration
- 1 Point Calibration
- 2 Point Calibration
- 5 Point Calibration
- 9 Point Calibration
- 13 Point Calibration

11.2.1 0 Point Calibration

0 Point calibration method does not establish an individual model of the participant's eye characteristics. In this case, a calibration is performed automatically without displaying the **Calibration** window. Gaze data will be immediately calculated after the calibration button has been clicked.

0 Point calibration is not recommended for highest accuracy, but it is

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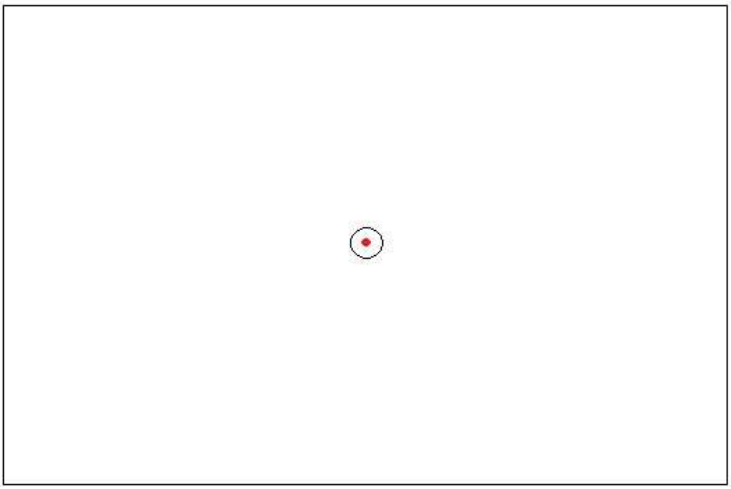
suitable for participants who have difficulty achieving a successful calibration.

Use 0 Point or 1 Point calibration only if using a higher number of calibration points is not adequate.

11.2.21 Point Calibration

1 Point calibration method has an improved accuracy over 0 Point calibration.

In this mode, a single calibration point is shown in the center of the screen.



1 Point Calibration method

This calibration mode is suitable for participants who have difficulty achieving a successful calibration with more than one calibration point.

Use 0 Point or 1 Point calibration only if using a higher number of calibration points is not adequate.

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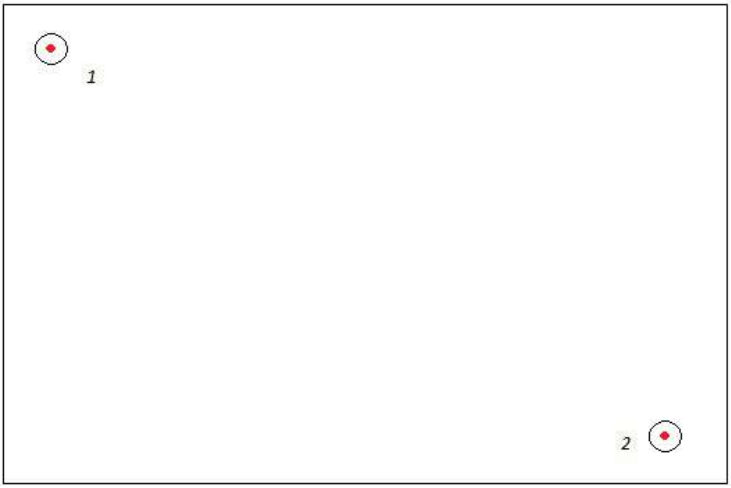
11.2.32 Point Calibration

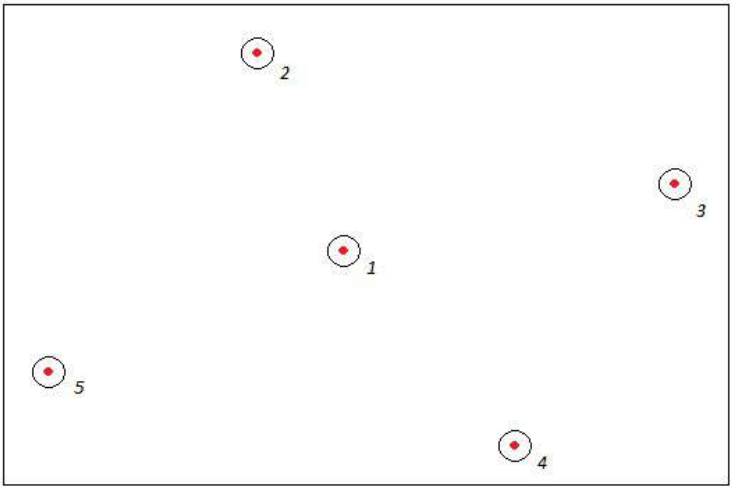
2 Point calibration method is quick and easy to perform.



2 Point Calibration method

11.2.4 5 Point Calibration

5 Point calibration method is the recommended method for most use cases.



5 Point Calibration method

This mode is a good balance between fast and comprehensive calibration and is suitable for data recordings where a more robust level of accuracy is required.

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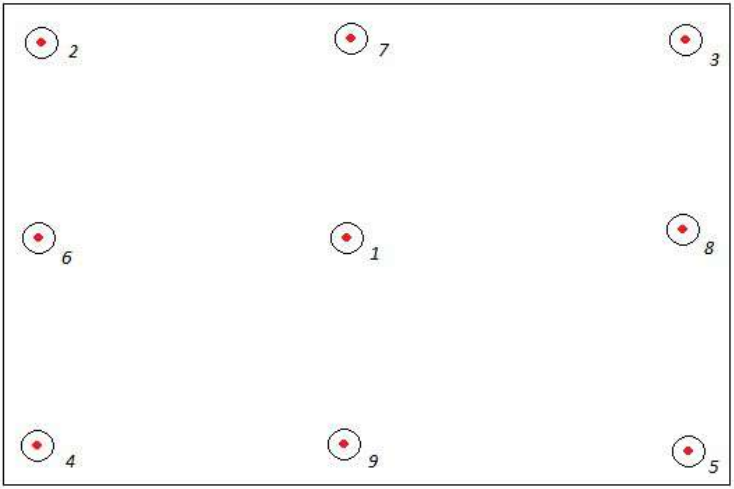
11.2.59 Point Calibration

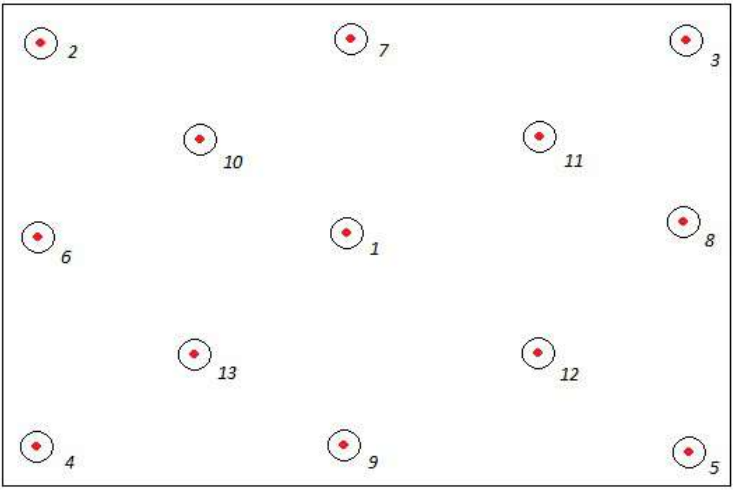
9 Point calibration method has a very high accuracy level. The participant, however, must be able to stay focused for a longer duration of the calibration process.



9 Point Calibration Mode

11.2.6 13 Point Calibration

13 Point calibration method has a very high level of accuracy. However, due to the number of calibration points, the participant must be able to stay focused for an extended duration of the calibration process.



13 Point Calibration Mode

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11.3 Setting Animation Speed

If a participant cannot follow the points shown on the screen, you can increase the amount of time of the animation between calibration points by selecting a slower animation speed.

iViewRED provides two animation speeds: **Normal** and **Fast**. These options are selected from the **Animation Speed** dropdown box on the **Calibration** tab.

11.4 Accepting Calibration Points

iViewRED provides three options for accepting calibration points: **Manually**, **Semi-automatically** and **Automatically**. These options are selected from the **Accept Points** dropdown in the **Calibration** tab. Calibration points can be accepted either by the operator or by the participant.

- **Manually**: Each calibration point is accepted manually by pressing the **Space Bar**.
- **Semi-Automatically**: The first calibration point is accepted manually by pressing the **Space Bar**. On subsequent calibration points, calibration points are accepted automatically.
- **Automatically**: In this mode, all calibration points are accepted automatically. This mode assumes that the participant is gazing at the calibration points while they are presented. For that, willingness of cooperation by the participant is required.

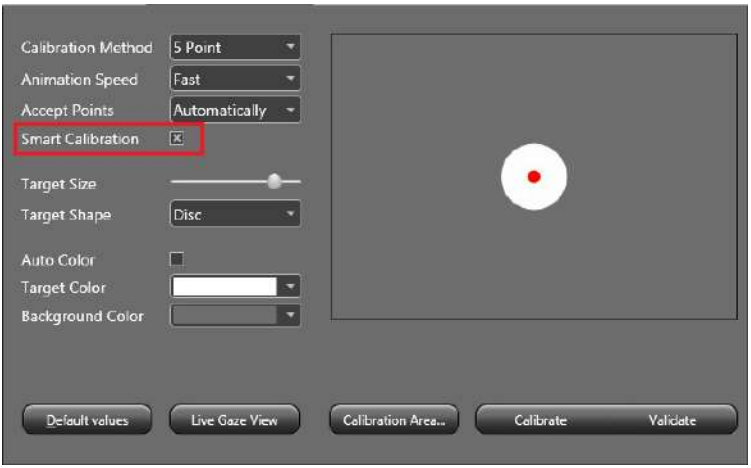
If **Smart Calibration** is enabled and the eye gaze of a participant cannot be tracked, the current calibration point will be dropped. If **Smart Calibration** is not active, iViewRED will wait until a fixation can be detected before advancing to the next calibration point. See

Using Smart Calibration.

11.4.1 Using Smart Calibration

When **Smart Calibration** is enabled, the calibration process waits two seconds for a fixation. If the data of one point is found unreliable (for example, the participant did not fixate on a point), then the data for this point will be dropped and this point will not be used to calculate gaze estimation parameters. This helps the calibration by removing bad fixations containing significant errors.

Smart Calibration is enabled in the **Calibration** tab.



Smart Calibration

When using **Smart Calibration** in combination with automatic acceptance of calibration points, a timeout of two seconds is provided for each point. If the system is

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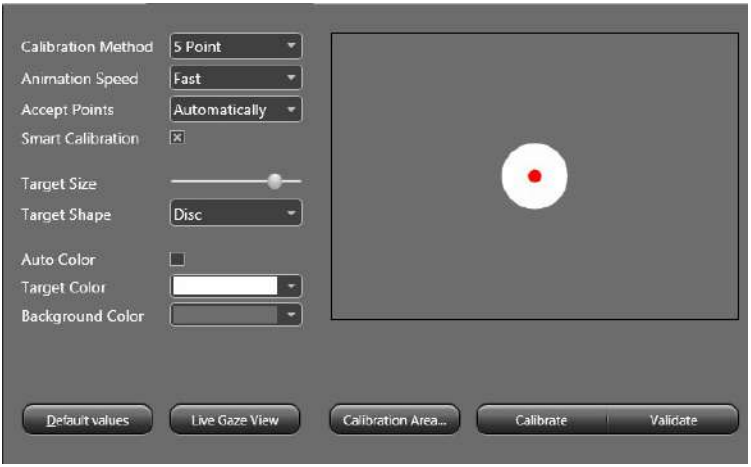
unable to track the eyes in that time, data from that calibration point is discarded.

11.5 Setting Calibration Point Styles

You can customize the calibration point styles to suit your environment and needs of the participants. The following shows the default calibration point style.



Default calibration point style

Customize the calibration using the following options:

- **Target Size** - Adjust the calibration point size for different use cases. For experienced participants a smaller target size may improve the calibration results. However, for inexperienced participants a bigger target size can improve the success rate.

- **Target Shape** - You can use either a disc or you can choose any image suitable for your needs. When Image is selected, the **Target File** option appears to select an image from the PC or network drive.

- **Auto Color -** The background color of the **Calibration** screen is set automatically using an average gray level of the current screen content.

- **Target Color** - When you select **Disc** for a target shape, you can then set the color of the calibration point using the **Available Colors** popup window to select from a range of grayscale colors.

- **Background Color** - If **Auto Color** is deselected, you can select from a set of grayscale colors for the background of the **Calibration** screen. The default color is gray.

The background color should be similar to the color of the stimuli used in the experiment to maintain the same level of brightness. Changing the brightness causes the participant's pupils to change, which can affect the calibration.

11.6 Running a Validation

The calibration can be validated (optional) with the same participant using a procedure similar to that used during the calibration process.

To run a validation:

1. After running a calibration, and with the same participant, click **Validate** on the **Calibration** tab.

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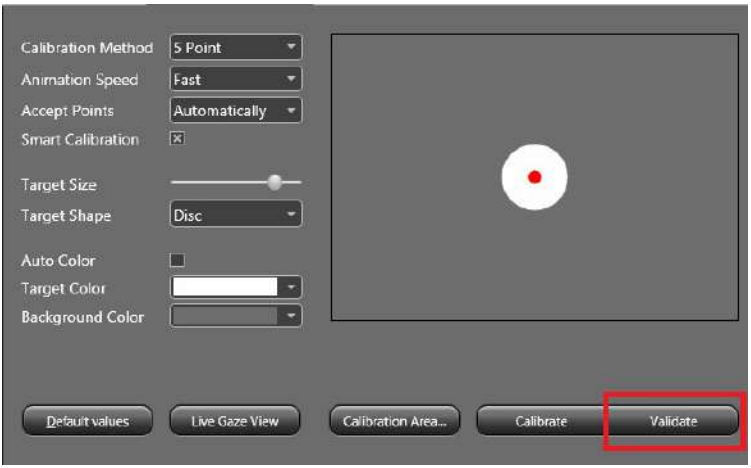

Click Validate to begin

2. *iViewRED* goes into full screen mode and displays the **Validation** screen.

3. The participant must focus on each of the validation points as they are displayed sequentially.

Validation points

4. Validation will begin immediately without any initial focus point.

5. When the validation is complete, *iViewRED* exits full screen mode and returns to the **Calibration** tab.

6. The results of the validation will be displayed in the **Validation Monitor**.

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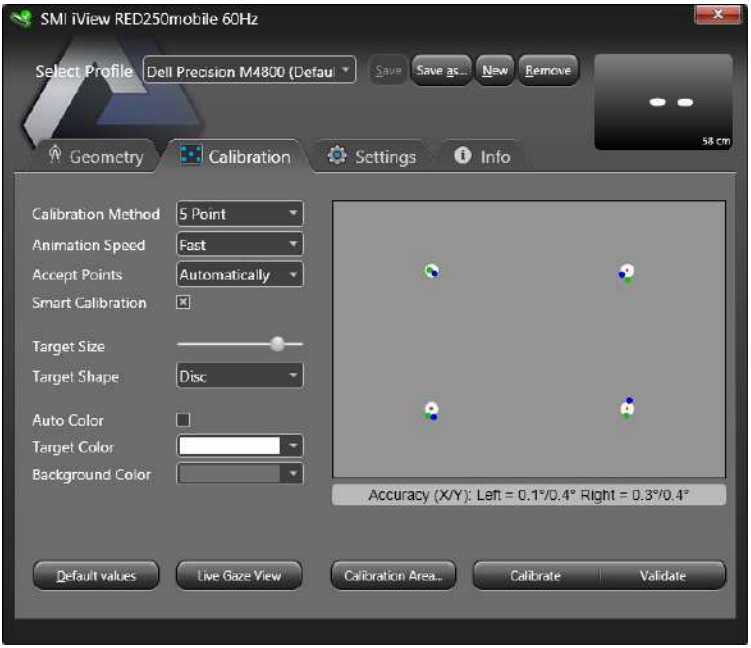


Validation results

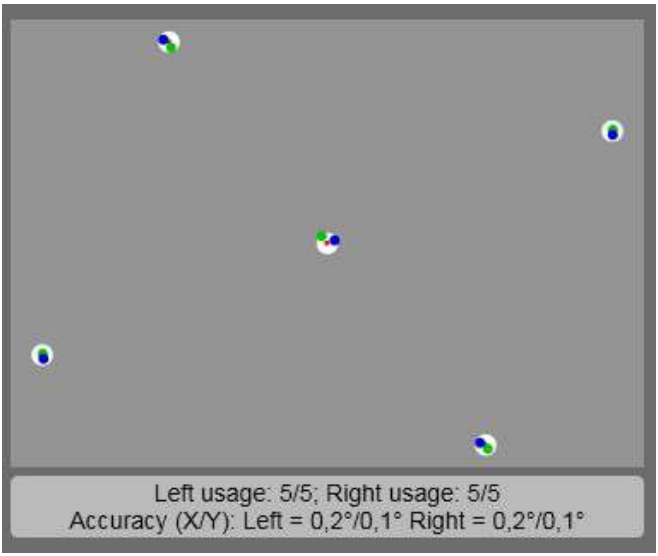
11.7 Understanding the Results

After a calibration has been performed, *iViewRED* returns to the **Calibration** tab. The results of the calibration are displayed in this tab.

For each eye, the ratio of accepted calibration points to the number of shown calibration points is displayed. The accuracy of the gaze is indicated by the value shown:

- The lower the value, the better the results.

The results also indicate if either both of the eyes were used during calibration.



Good calibration results

The results of a calibration have two parts:

- **Left Usage and Right Usage** - For each eye, the ratio of accepted calibration points to the number of shown calibration points is displayed.

- **Accuracy (X/Y) Left Eye and Right Eye** - The accuracy of the gaze is indicated by the value shown. The lower the value, the better the results.

Blue and Green indicators

- **Blue dot** - indicates the right eye.

- **Green dot** - Indicates the left eye.

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11.8 Recalibrating on a Point

Recalibration on a calibration point can be done if the calibration results indicate that the participant did not focus sufficiently on an individual calibration point.

When a calibration point has been recalibrated, the entire calibration will then be adapted afterwards in one of the following ways:

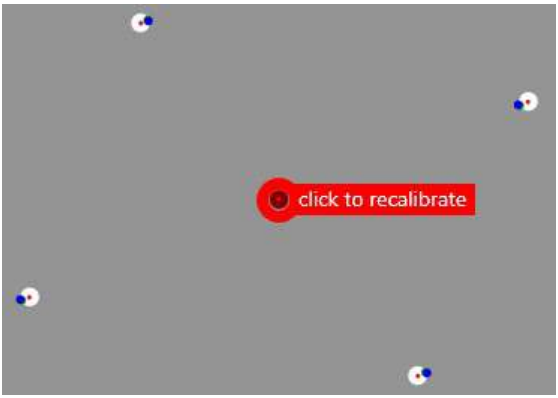
- The data from the selected point with be replaced with new data from the recalibrated point.
- The data from the previously missing point will be included in the calibration model.

Recalibration can only be done after a calibration has been performed, and only if no calibration settings were changed or if another tab was selected. If another tab was selected or if the calibration settings were changed, the display will be turned to **Calibration Point Setting** mode and recalibration is no longer possible.

To recalibrate on a specific calibration point:

1. Using the mouse, move over the point to be recalibrated.

2. A floating hint will appear - **Click to recalibrate**.



Recalibrating on a point

3. Click on the hint and follow the process as in running a 1 Point calibration. See Running a Calibration.

4. The new data will be merged with the previous calibration and the entire calibration will then be adapted as described above.

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Setting the Calibration Area

Chapter

12

12. Setting the Calibration Area

The default positions of the calibration points are optimized to gain best performance over the full screen area. If you use only a part of the screen, you may want to consider moving the calibration points to this certain area.

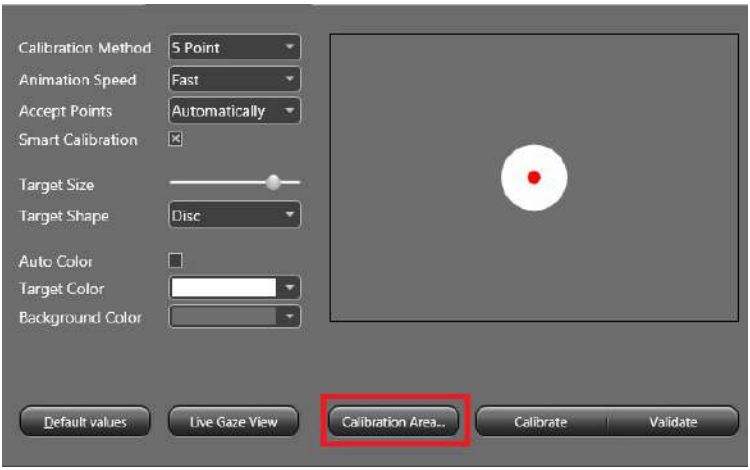
Changing the position of calibration points has a severe impact on accuracy.

The **Calibration Area** can be reset for all calibration methods, except 0 Point and 1 Point calibration.

To set the calibration area:

1. From the **Calibration** tab, select the number of calibration points from **Calibration Method**.

2. Click **Calibration Area**.



Click Calibration Area

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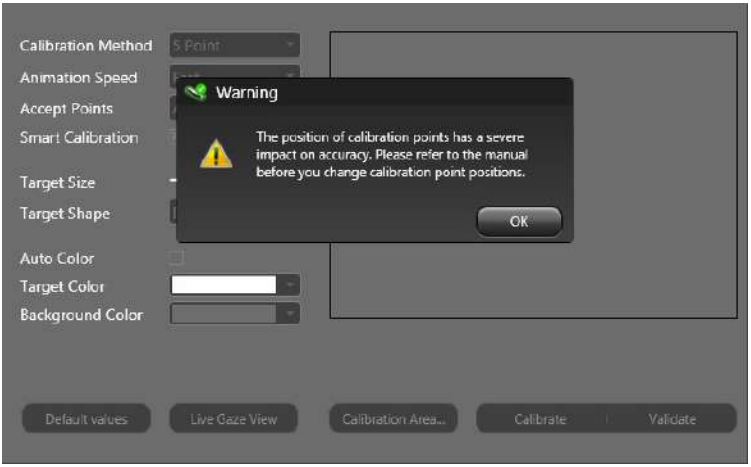
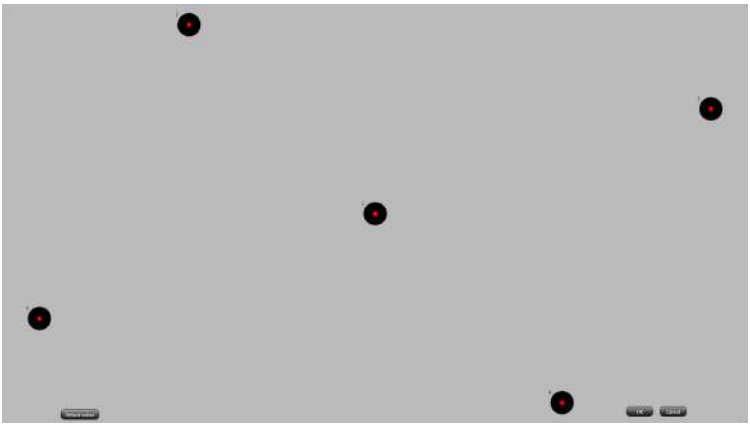
3. When changing the position of a calibration point, the accuracy of the calibration may be affected. Specific guidelines are provided in this section for the placement of calibration points. Refer to these sections before making any changes. Click **OK** to accept the warning.



Calibration area w arning

For positioning of calibration points, refer to the respective sections below for each calibration method.

4. The application will go into full screen mode with the target points showing in each quadrant.



Calibration Area showing 5 points

5. Adjust the position of the target points and click **OK**.

6. If necessary, any changes made can be reset to default by clicking **Default values**.

7. When done, click **OK** to return to the **Calibration** tab.

For best results across the screen, the calibration points shall cover the whole area of the screen. The calibration point coordinates should be distributed equally along the x and y axis.

When resetting a 2 Point Calibration, calibration points MUST BE placed on a diagonal from the top left corner to the bottom right corner in the stimulus area.

For all other Calibration Methods it is generally recommended, but not mandatory, to place the calibration points in the same layout as in the default layout.

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Using Live Gaze View

Chapter

13

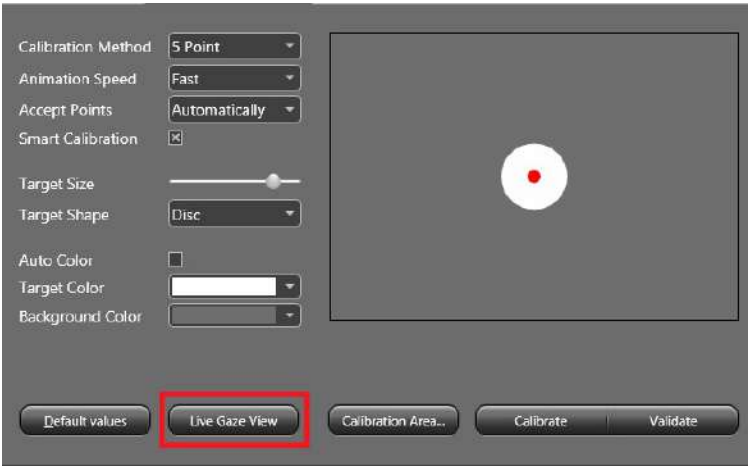
13. Using Live Gaze View

Live Gaze View can be used to show the area on the screen at which the participant is gazing.

Run a calibration before using this **Live Gaze View** for best performance.

To use **Live Gaze View**:

1. On the **Calibration** tab, click **Live Gaze View**.



Click Live Gaze View

2. The **Live Gaze View** button turns red while this mode is activate.

3. The entire screen dims except the area on the screen to which the participant attends. This area is shown as a lit circle, as in a flashlight shining into a dark area. The refresh rate of the Live Gaze View is determined by screen refresh rate.

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Live Gaze View

4. Exit by clicking the **Live Gaze View** button.

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Setting the Tracking Mode

Chapter

14

14. Setting the Tracking Mode

iViewRED provides four tracking modes that can improve the eye tracking of participants with various eye characteristics. This can be eye conditions such as "lazy eyes" or having a glass eye. It can also assist tracking of participants wearing glasses or contact lenses.

- **Smart Binocular** - Both eyes are tracked. Tracking continues if one eye is temporarily closed.

- **Monocular Left** - Only the left eye is tracked. This is useful if the participant has a right glass eye or if the right eye has characteristics that make it undesirable to track for the purposes of the experiment; for example, this is useful if the vision of the right eye of the participant is much weaker than the left eye.

- **Monocular Right** - Only the right eye is tracked. This is useful if the participant has a left glass eye or if the left eye has characteristics that prevents it from being tracked; for example, this is useful if the vision of the left eye of the participant is much weaker than the right eye.

- **Smart Tracking** - Based on the calibration results, the software intelligently decides whether to use one or both eyes for tracking. This ensures the best data quality in settings where highest robustness is required, for example, when participants might have severe vision impairments on one eye. Recommended only for calibrations using five and more points.

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Additional Information

Chapter

15

15. Additional Information

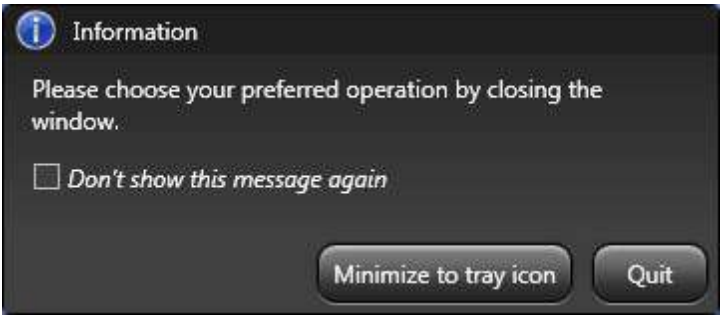
This section includes additional topics for the *RED250mobile Eye Tracker*.

15.1 Shutting Down iViewRED

To shut down *iViewRED*:

1. Click the standard Windows™ close icon (the "X" icon).

2. Click **Quit** from the dialog that appears.



3. *iViewRED* will now shut down.

4. Disconnect the *RED250mobile Eye Tracker* from the USB port and safely store the device in its Carrying Case.

You can also minimize the application by clicking **Minimize to tray icon**.

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15.2 Troubleshooting

My eye tracking experiment is running slow

Verify that your system setup and the experiment setup matches the system recommendations and requirements.

Certain background processes and services require substantial system resources during execution. While this does not affect the system during idle times, those background processes may disturb a running eye tracking experiment. If you notice a degradation in system responsiveness, you may consider the following points:

- Disable the background scan function of your virus scanner. This function scans newly started executables and various file formats while they are read in from the hard disk drive. Use the on-demand virus scan function instead.

- Make sure no CPU consuming screen saver is automatically activated during a running experiment. It is best to completely switch off the screen saver during an experiment.

- You may also deactivate any auto-update functions. While background downloading of files does not normally use too much system resources, confirmation dialogs and update notices may disturb an experiment.

- Check the power configuration settings when using a Notebook PC. In the Windows™ Control Panel, select the Performance and Maintenance category. Start the Power Options applet and select the ”Presentation” entry in the Power Schemes list.

- Disable the USB selective suspend settings on a Desktop PC. This prevents the USB port from suspending during the usage of *iViewRED*. To disable this setting in Windows™ 7:

a. Select **Control Panel** > **Hardware and Sound** > **Power Options**.

Pow er Options dialog

b. In the **Power Options** window, select **Change Power Settings** from the **Preferred Plan** area, and then select **Change plan** settings.

c. In the **Changes settings for the plan** window, select **Change Advanced Power Settings**.

d. In the **Power Options** dialog, click the plus sign next to **USB Settings**, then click the plus sign next to USB selective suspend setting.

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e. Click **Setting** and then choose **Disabled** from the dropdown list.

f. Click **OK** to close the dialog.

iViewRED does not start

It is not sufficient to simply copy the *iViewRED* application directory to another PC. You must use the *iViewRED* Installation package. This ensures, for example, that the required Microsoft .NET Framework Version 4.0 or above is installed properly.

You cannot start *iViewRED* from a network share / network drive because of .NET security restrictions.

I am getting an error message

iViewRED has several error states:

- **Not Connected** - This is indicated by the  in the application title bar. Ensure that the *RED250mobile Eye Tracker* is connected to the USB port. If the *RED250mobile Eye Tracker* is connected and you are still getting a **Not Connected** status, the USB port may not be functioning or you are using the wrong USB port (USB 2.0 instead of USB 3.0 for example). In this case, ensure you are using the correct USB port or try another USB port or disconnect any unneeded USB devices.

- **Firmware Outdated** - This indicates that you need to download and install the latest version of the software using the **Check for updates** link in the **Extras** tab of the *iViewRED* application.

See Checking for Software Updates.

Can I use the *RED250mobile Eye Tracker* with other USB connected devices?

The *RED250mobile Eye Tracker* is a high performance USB device that requires a certain amount of available bandwidth from the USB port. When other high performance USB devices are plugged into USB ports such as USB drives, webcams, WIFI adapters, the available bandwidth of USB may become insufficient.

The *RED250mobile Eye Tracker* also draws the power it needs from the USB port. If some other USB device is absorbing current above the USB specification, this may also lead to problems. Try disconnecting unneeded USB devices.

See also the description for setting **Power Options** above

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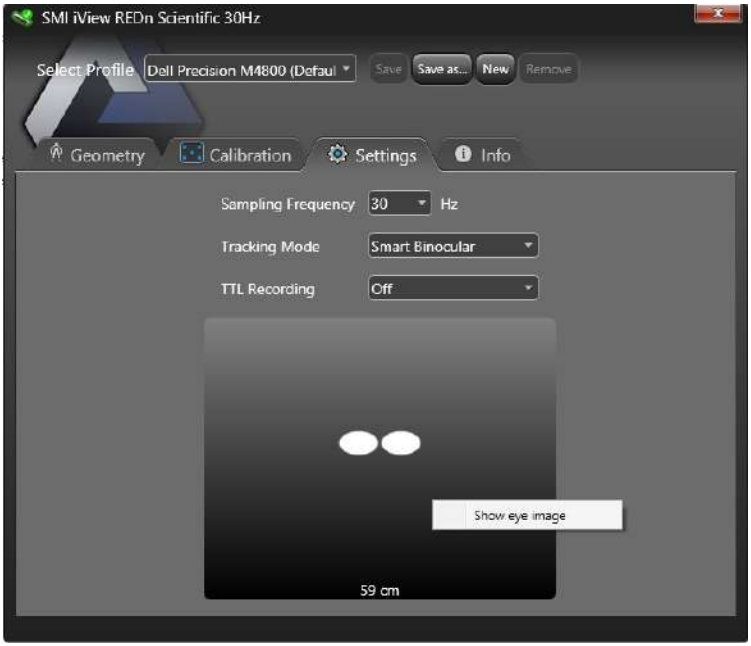
15.3 Showing Eye Images

Eye images from the *RED250mobile Eye Tracker* can be shown on the **Settings** tab. These images are hidden by default.

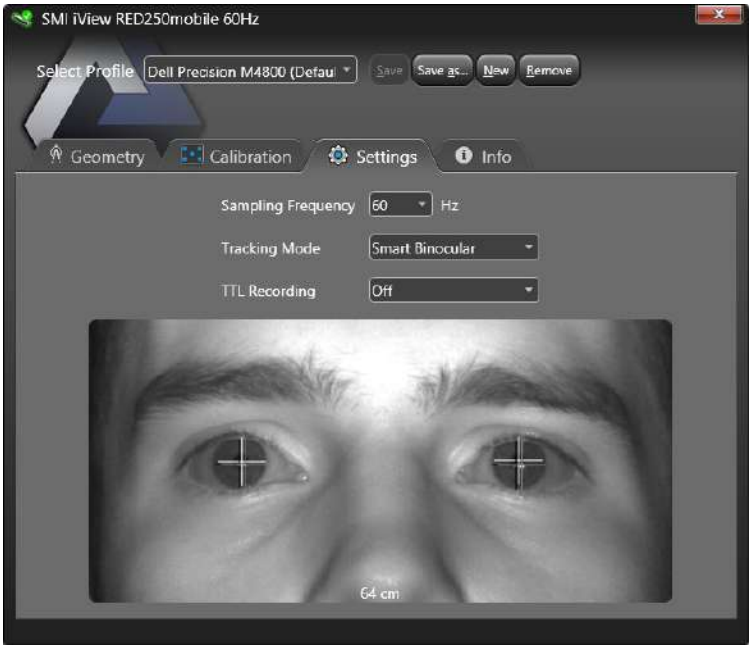
To show eye images:

1. Right-click on the **Eye Tracking Monitor** in the **Settings** tab.



Show Eye Images

2. The processed eye images from the *RED250mobile Eye Tracker* will be displayed.



Show ing Eye Images

3. Right-click on the **Eye Images** and click **Hide eye images** to return to the **Eye Tracking Monitor**.

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15.4 Removing the Mounting Bracket

The magnet used to hold the Mounting Bracket to the Magnetic Strip is very strong. When the Magnetic Strip is not firmly glued to a surface, removing the Mounting Bracket from the Magnetic Strip is not easy. You can detach the Mounting Bracket from the Magnetic Strip by inserting a pin the detachment hole provided on the Mounting Bracket.

Detachment hole for removing Mounting Bracket

15.5 Checking for Software Updates

To update *iViewRED*:

1. On the **Info** tab, click **Check for Updates**.

Check for Updates on the Info tab

2. If no current updates are available, no executable will be downloaded.

3. If a newer version is available, an executable will be downloaded. Save it to your local drive for installation.

4. Install the update as described in Installing iViewRED Software.

15.6 iViewRED Software Structure

iViewRED includes a Server and a Client. As a structure, *iViewRED* consists of an Application Layer, a Driver and Service Layer, and a Physical Layer. Each layer provides status messages to the Windows ™ operating system.

Application Layer This is the top layer and consists of

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	the *iViewRED* application and additional application software such as the *SMI Experiment Suite 360°,* or other 3rd party applications. Application software accesses the *RED250mobile Eye Tracker* through an exposed API (Application Programming Interface) provided in the Driver and Service Layer. For further information consult the SDK User Guide.
Driver and Service Layer	This layer consists of a server and the USB Driver provided by the Windows™ operating system. It provides an API through which applications in the top layer communicate with the *RED250mobile Eye Tracker*. The server provides the kernel which processes information from the *RED250mobile Eye Tracker* and sends the resulting coordinates to the application layer via the API. When *iViewRED* is running, the **Connected** status indicator icon is provided in the Windows™ Taskbar.
Physical Layer	This layer consists primarily of the *RED250mobile Eye Tracker*. It communicates with *iViewRED* via

USB.

15.7 Interfacing with other Applications

If you wish for another application, such as stimulus presentation software, to interact with *iViewRED*, both applications need to be interfacing properly.

Interfacing differs whether you are working with Experiment Center or a third party application. It also differs depending on whether your application runs on the same PC as *iViewRED* or if you are working in a Dual PC configuration.

15.7.1 Interfacing with SMI Experiment Center

Interfacing with SMI *Experiment Center*™ is particularly simple. Before running a designed study, *iViewRED* needs to be started and the *RED250mobile Eye Tracker* connected to the PC, then data acquisition can start.

Before running a study in *Experiment Center*™, make sure that tracking mode and sampling rate selection in *iViewRED* as well as the Geometry Settings have been adjusted to the setup and experimental needs.

When using *Experiment Center*™ and *iViewRED* on the same PC, be sure that **Use One PC Setup** is checked in *Experiment Center*™'s **Global Setting** dialog.

Consult the *Experiment Center*™ User Guide for further information.

15.7.1.1 Working in a Dual PC configuration

It is possible to use *Experiment Center*™ and *iViewRED* on different PCs. In this case, after each recording the IDF file is automatically transferred from the *iViewRED* PC to the Stimulus PC running *Experiment Center*™.

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To establish a connection, go to *Experiment Center*™'s **Global Settings** dialog. Uncheck **Use One PC Setup**. Enter the IP address and port found in the Info tab of *iViewRED* in the respective fields for the **iView X System** in *Experiment Center*™.

A firewall may block the communication. Consult *Experiment Center*™'s User Guide on how to unblock the firewall and for further information.

15.7.2 Interfacing with Third Party Applications

If third party application is running on the *iViewRED* PC (the PC that the *RED250mobile Eye Tracker* is connected to), the programs can be connected using the `localhost` address. See Application Running on iViewRED PC.

When *iViewRED* is running on a PC different from the PC that the application is running on, a network connection needs to be established. See Application Running on Second PC (Dual PC Setup).

15.7.2.1 Application Running on iViewRED PC

When *iViewRED* and the application interacting with *iViewRED* are running on the same PC, the connection can be automatically initialized if the application uses the SDK command `iV_ConnectLocal`. In this case, no further settings are required.

If the application uses the SDK command `iV_Connect`, a network connection will need to be established. In this case, locate the part of your application where a network communication can be configured. In an existing application, this would use the command `iV_Connect (SendIPAddress, SendPort, RecvIPAddress, ReceivePort)`.

When both applications are running on the same PC, use a `localhost` network connection. Typically, this is realized using the IP address `127.0.0.1` for both `SendIPAddress` and `RecvIPAddress`. You can find IP Address and Port of the *iViewRED* PC on the Info Tab. These will need to be inserted for `SendIPAddress` and `SendPort`. `RecvIPAddress` and `ReceivePort` are determined by the PC running

your application.

IP Address and Port

For further information, consult the SDK User Guide or the User Guide of the application you are using.

15.7.2.2Working in a Dual PC configuration

When *iViewRED* and the application interacting with *iViewRED* are running on two different PCs, the connection will need to be established physically with a hardware ethernet network connection. In addition, the application interacting with *iViewRED* will need to be configured for communication.

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Locate the part of your application where the network communication can be configured. If you are writing your own application use the command `iV_Connect(SendIPAddress, SendPort, RecvIPAddress, ReceivePort)`.

You can find IP Address and Port of the *iViewRED* PC on the Info Tab. These will need to be inserted for `SendIPAddress` and `SendPort`. `RecvIPAddress` and `ReceivePort` are determined by the PC running your application.

IP Address and Port

For further information, consult the SDK User Guide or the User Guide of the application you are using.

15.8 Evaluating Eye Tracking Data

The fastest way to conduct and analyze eye tracking experiments is by using SMI's comprehensive software package *Experiment Suite*™. Eye tracking data is saved in a binary iView Data File (IDF) format. Also when working with other applications, this data can be analyzed with SMI's *BeGaze*™ analysis software, or processed with SMI's *IDF Converter* tool for custom evaluation purposes.

15.8.1 Evaluation with SMI Experiment Suite

For most eye tracking experiments, the combination of using SMI *Experiment Center*™ for experiment design and execution and *BeGaze*™ for analysis provides powerful and easy to use opportunities. Refer to *Experiment Center*™ and *BeGaze*™ User Guides for further information.

When using Experiment Center for running the eye tracking study, make sure that the proper geometry and tracking modes for the experiment are selected in *iViewRED*.

Also when working with other applications, the generated IDF file can be analyzed with SMI's *BeGaze*™ analysis software.When *BeGaze*™ loads IDF files, it can automatically separate the data stream into single trials. *BeGaze*™ uses messages of a defined format to achieve this trial separation. When designing an experiment where later trial separation in *BeGaze*™ is desired, use the SDK command `iV_SendImageMessage(ImagePath)` at the point of the experiment when the trial separation is desired. Refer to the SDK User Guide for further information.

15.8.2 Working with the iView Data File

The IDF file can be loaded either in *BeGaze* or into the *IDF Converter*, which exports various kinds of data, such as pupil size and position, messages, trigger status and gaze position and into ASCII readable text for custom evaluation.

The *IDF Converter* is part of the *iTools* package which can be downloaded from the SMI web page.

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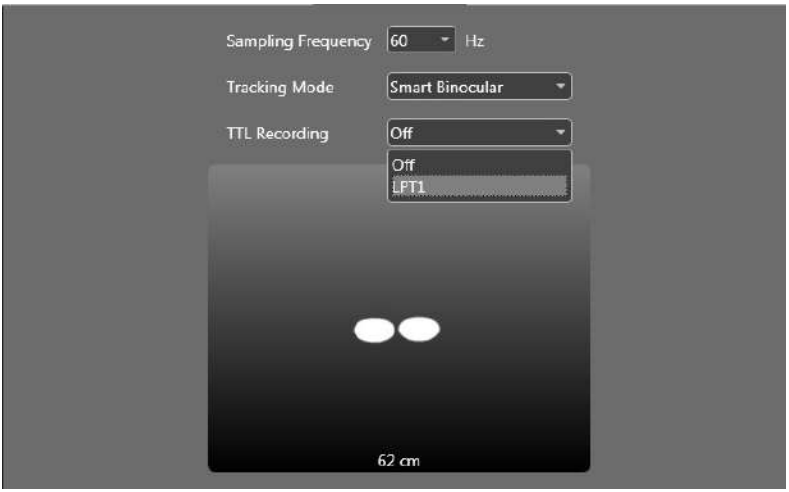
15.9 Working with TTL Triggers

iViewRED is capable of receiving up to 8 TTL signals on 8 lines at the same time through Parallel Input. You can enable the TTL Recording at the **Settings** tab throughout the **TTL Recording** drop down menu. The drop down menu contains all LPT ports on the PC that are supported for TTL recording. If no LPT port is available the list only contains the **Off** entry.



A trigger signal is an electrical low-voltage TTL signal. There are two possible states, trigger HIGH (5 V) and trigger LOW (0 V). The duration of a trigger signal should be at least 1.5 samples long, depending on the used sample rate. For a 60 Hz sampling rate, a minimum trigger duration of 25 ms is recommended.

Trigger signals will be time stamped and recorded in the IDF file. In the IDF export, trigger signals are available as a Trigger column if **Show**

Trigger is selected in the Export Options. Trigger signals can be represented either as hexadecimal or decimal values.

When working with TTL signals, make sure that an LPT port is installed on your PC. Up to eight lines of the LPT port can be used as input on Pins 1 and 10 - 16. Pins 1, 14 and 16 can only be used on ECP-ready LPT ports.

The other channels are ignored. Usually LPT connectors use grounding switch, which means that the input channels are HIGH by default. It is recommended to use the falling edge of the trigger signal.

For further information, consult the SDK User Guide.

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License Agreement and Warranty

Chapter

16. License Agreement and Warranty

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About SMI

Chapter

17. About SMI

SensoMotoric Instruments (SMI) is a world leader in dedicated computer vision applications, developing and marketing eye and gaze tracking systems and OEM solutions for a wide range of applications.

Founded in 1991 as a spin-off from academic research, SMI was the first company to offer a commercial, vision-based 3D eye tracking solution. We now have over 20 years of experience in developing application-specific solutions in close collaboration with our clients.

We serve our customers around the globe from our offices in Teltow, near Berlin, Germany and Boston, USA, backed by a network of trusted local partners in many countries.

Our products combine a maximum of performance and usability with the highest possible quality, resulting in high-value solutions for our customers. Our major fields of expertise are:

- Eye & gaze tracking systems in research and industry
- High speed image processing, and
- Eye tracking and registration solutions in ophthalmology.

More than 5,000 of our systems installed worldwide are testimony to our continuing success in providing innovative products and outstanding services to the market. While SMI has won several awards, the largest reward for us each year is our trusted business relationships with academia and industry.

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Index

 © 2015 SensoMotoric Instruments (SMI)

- T -

 © 2015 SensoMotoric Instruments (SMI)

- U -

- V -

- W -