

# Dikablis - The Eye Tracking System

## User Manual Dikablis Software

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*For Dikablis Software Version 2.0*

*Revision 09/2011*



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Dear customer,

With the Dikablis eye tracking system from Ergoneers, you have chosen innovation, quality, performance and reliability. Dikablis will optimally support you in all your eye tracking test and research endeavors and guarantee a maximum of efficiency and convenience. Ergoneers is supplying you with a complete and consistent hardware and software system for scientific eye tracking. Compatibility problems between hardware components or internal data flow constraints are now a thing of the past.

Dikablis is used to track and experimentally analyze the glance direction, the eye and head movement of test persons. By integrating the fundamental system components into the head unit, the system provides the test person with unrestricted freedom of movement. The LiveView integrated in the recording software allows the glance behavior of test persons, who can move freely about the room, to be recorded and simultaneously monitored on the screen.

The list of possible applications for the Dikablis system is long, ranging from the assessment of design and structural accessories through to the design of behavior-optimized user interfaces, or to the evaluation of glance behavior in critical safety situations. The user does not need to have any previous experience in the field of eye tracking. Both amateurs and experts alike can utilize of the system's full potential.

The purchased package contains analysis software which enables the user to process the test results both intuitively and simply. With the standard software, it is possible to manually edit the data recorded during the test. Optionally, Ergoneers can now offer you the D-LAB software module, an independent module for the automatic analysis and processing of the recorded data. With D-Lab, the data no longer needs to be manually processed. D-Lab offers you the ability to display the recorded glance behavior in a factually concise, high quality graphical display.

Our product portfolio comprises the following Dikablis variants: Dikablis Cable, Dikablis Wireless and Dikablis Wireless Plus. The alternative you have chosen greatly depends on its intended area of usage.

How to work with the software is explained step-by-step in this manual. Our aim is to make the Dikablis system easy for you to use.

Thank you for choosing to purchase an Ergoneers product. We hope you enjoy using your new Dikablis eye tracking system.

Your team from Ergoneers

## 1 Initial Steps

### 1.1 Scope of Supply

The following software is already installed on the computer supplied, regardless of whether you have purchased the cable or wireless variant:

- Software for recording the glance data
- Analysis software for the subsequent adjustment of the calibration and pupil detection features
- Player for playing back the recorded glance data
- You are also supplied with an installation CD for the recorder, the analysis software and the player.

### 1.2 System Requirements

***We can only guarantee that the recording software will work properly on the recording computer supplied.*** The analysis software and the player can also be installed on the following systems:

- Windows XP, 32bit
- Windows 7, 32bit

## 2 Dikablis Software

Three independent Ergoneers software systems, which can be started as required, are already pre-installed on your Dikablis computer. During the test procedure, the *Dikablis Recording* software is the main governing software module. The eye tracking data is recorded using it.

The data generated with the recording software is processed using the *Dikablis Analysis* software. The generated eye tracking data can be reworked using this software by adjusting the calibration and/or the pupil detection feature. It is also possible to analyze the data manually.

The *Dikablis Player* is a license-free application for playing back the recorded eye tracking data. With it, you can view the eye tracking data on any computer. The player is only used for displaying the data and cannot be used to perform analyses.

Our product range also includes the *D-Lab und D-Lab Control software package* which allows the eye tracking data to be analyzed automatically. D-Lab also offers a range of different visualization modes, such as heat maps or glance flow diagrams. Task intervals can also be marked while the eye tracking data is being recorded to allow the glance characteristics to be analyzed in relation to the individual tasks.

### 2.1 Installation and System Requirements

All three software modules are already installed on the computer supplied. The recording software can only be run on this computer (due to the special hardware needed to record the eye tracking data). The analysis software and the player can also be installed on any other computers. The system requirements to do so are:

- A Windows XP or Windows 7, 32bit operating system
- At least a 2 GHz CPU
- At least 1GB RAM
- Adequate hard drive storage space

Please note that local administrator rights are needed before the Dikablis software can be installed on the computer. To install one or more of the three Dikablis applications, proceed as follows:

1. Place the supplied Dikablis installation CD in your computer's CD drive. The installation is started automatically and the window shown in Figure 2-1 appears.
2. Select the applications which you wish to install. The following options are available: *Dikablis Recorder* for recording eye tracking data, *Dikablis Analysis* for post-editing the data and the *Dikablis Player* for playing back the glance behavior.
3. Press the "Install" button to start the installation sequence. Confirm any dialogs which may pop up. The selected applications are installed and the corresponding shortcuts generated on

the desktop. An Ergoneers →Dikablis folder with shortcuts for the installed applications is added to the computer's start menu.

Please note that the applications need to be installed for each user who wishes to work with them (see also question 2 in section 3 “FAQ”).



Figure 2-1: Dikablis installation - selection window

To uninstall a Dikablis application, open the control panel on your computer and use the program administration feature integrated in your user interface for removing applications.

## 2.2 Dikablis Recorder

You can record eye tracking data with the Dikablis recording software. The following sections provide a general outline of the functions and the basic structure of the recorder. The functions of the recorder are then described in an application-oriented manner using a series of short learning modules. The aim of this is to introduce you to the key functions of the program. You can work through the learning modules one by one or select individual modules which will allow you to gather information about specific topics.

### 2.2.1 General Outline

The program's main functions are marked in Figure 2-2 and explained in the following:

In the *LiveView preview window*, the glance behavior of the test person can be followed live and at any time. Using the *visualization options*, you can select what is displayed in the preview window. You can choose between the field camera image, the eye camera image and the blending mode. The *blending mode* is a semi-transparent blending of the field and eye camera images. The transparency factor can be adjusted using the "blending factor" controller. The preview window can also be displayed in the full image mode.

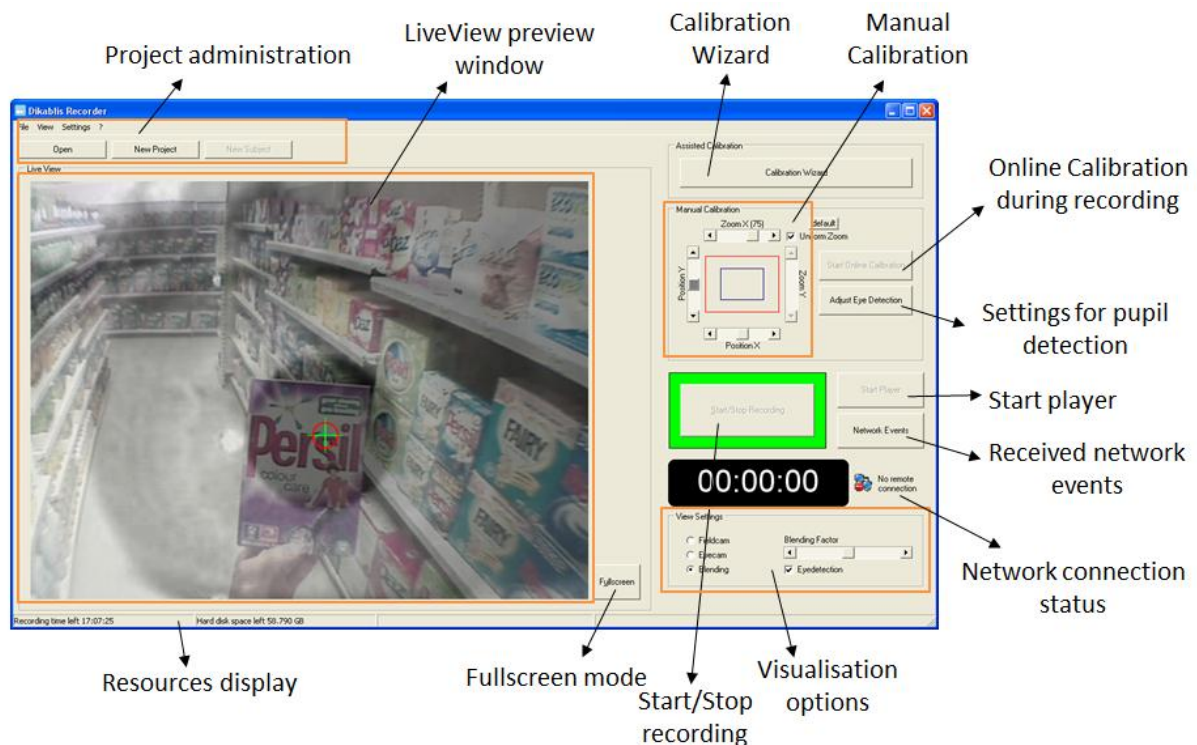


Figure 2-2: general outline of the Dikablis Recorder

The *project administration* area is used to create new projects and open existing ones. Subjects can be generated here for the individual test persons. It is also possible to define project-specific triggers for the online marking of relevant events. These triggers can only be used in combination with the manual analysis feature. When analyzing the eye tracking data automatically with D-Lab, the task intervals are marked using D-Lab Control.



The *calibration assistant* can be used to help you adjust the eye camera, configure the pupil detection feature and calibrate the test person correctly. It uses simple steps to guide you through the process of entering the optimum test person settings.

The *settings for pupil detection* can also be adjusted without the aid of the calibration assistant. There is also the option of manually fine-tuning the calibration at any time in the *Manual Calibration* area.

The *eye tracking data is recorded* by pressing the "Start Record" button. The recorded data can be played by *starting the Dikablis player*. The calibration settings can be adjusted online at any time, even if data is currently being recorded. Behind the *Network Events* button there is a window which displays all of the network events and triggers which were received and activated while the eye tracking data was recorded.

In the status bar of the recorder window, you can find the *resources display*. It is here that you can find information about how much recording capacity is currently remaining on the hard disk.

The recording software can be remotely controlled via the network. The project can be managed, the recording process and events monitored by network control. This allows it to be easily integrated in your measuring system's existing infrastructure and to be synchronized with other modules. In addition, the network connection can be used to access the eye tracking data collected during the recording, such as focal point co-ordinates or pupil characteristic values. This allows you to trigger events or control the system depending on the glance direction.

If the existing application options are insufficient, you can integrate your own functions into the system. With a special programming interface, you can have full real-time access to all eye tracking data. All of the images and eye tracking data are supplied online via this interface.

## 2.2.2 Project Structure and Saved Data

The data recorded with the Dikablis Recorder is structured into projects and subjects, as shown in Figure 2-3. A project contains all of the subjects for an eye tracking study. A new subject is generated for each test person as part of this project. The eye tracking data is saved on the subject level. When doing so, a differentiation is made between online and offline data. The online data is raw data gathered during the recording. If a subject is reworked using the analysis software, the changes are saved as so-called offline data. This ensures that the raw data will always exist and cannot be written over.

Newly created projects are saved in "C:\<projectname>" as standard. As long as you work on a project and record new subjects, we would advise that you do not change the repository path. However, you can move the complete (!) project folder into a different folder or copy it onto an external data carrier once your project is complete. Here it is very important that you move the complete project folder as it contains a defined structure which cannot be changed.

On the subject level, a folder called "online" will be created once you start recording data. The following eye tracking data is saved in this folder:

- the video from the field camera as an "avi" file with the resolution 768x576 pixels, PAL, 25 fps
- the video from the eye camera as an "avi" file with the resolution 384x288 pixels, PAL, 25 fps
- journal file in text format

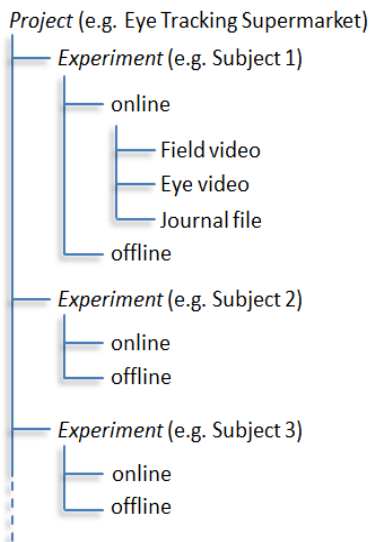


Figure 2-3: project structure

The journal file contains all of the information needed to assign the focal point calculated in the eye video to the field video. This file also includes a time axis, the co-ordinates of the focal point in the eye and field camera image, geometric data for the pupil, the marked events and triggers. For a detailed description of what is contained in the journal file, please refer to Table 2-1.

The video data is saved in the "avi" file format. You can play back any of these videos with Microsoft Media Player. Even so, you will need the Dikablis player or the Dikablis analysis software in order to combine the eye tracking data from the journal file with the video data or to analyze and/or edit the eye tracking video. The size of the video file is limited to 1 GB for system reasons. If you record for a long time, the recorded videos may exceed this. To prevent this happening, the videos are split up during recording (without any material being lost) once this maximum size has been

reached. This means that it is possible for more than one field video and one eye video to exist for each recording. The individual parts are then automatically joined together during playing and analysis in all of our applications. This process does not require any user intervention.

Column number	Name	Value range	Description
1	Index	Consecutively numbered	Image number (25 images per second) beginning with 0
2	timestamp	Number	Counts up in milliseconds from the time when the recording computer is started. In addition, the GMT time when the application was started can be found in the first line of the journal file. To calculate the GMT time of a frame, add the time from the frame's time stamp to the GMT time when the recorder is started.
3	eyeroihoriz	0-500	Calibration setting
4	eyeroivert	0-500	Calibration setting
5	eyeroizoomx	0-300	Calibration setting
6	eyeroizoomy	0-300	Calibration setting
7	blendmode	0 or 1	Blending mode setting: "plus" or "over"
8	blendfactor	0-255	Sets the transparency factor for the blending mode
9	onlinecalib	0 or 1	0: No online calibration 1: Calibration was performed online
10	eye_valid	0 or 1	0: Pupil was not detected 1: Pupil was detected
11	eye_x	0-768	When divided by two, this value provides the horizontal position* of the pupil in the eye camera video in pixels
12	eye_y	0-576	When divided by two, this value

Column number	Name	Value range	Description
			provides the vertical position* of the pupil in the eye camera video in pixels
13	eye_w	Number	Width of the pupil in pixels
14	eye_h	Number	Height of the pupil in pixels
15	eye_a	Number	Area of the pupil in pixels
16	field_x	0-768	Horizontal position* of the focal point in the field camera video in pixels
17	field_y	0-576	Vertical position* of the focal point in the field camera video in pixels
18	displaymode	0, 1 or 2	Configuration of the preview window: 0: Field camera image active 1: Eye camera image active 2: Blending mode active
19	displayeyedetection	0 or 1	0: Pupil detection deactivated 1: Pupil detection active
20	event	Any String	Marks events which can be recorded in the eye tracking data via the network interface. Is also used for marking the task intervals with D-Lab Control.
From column 21	Name of the trigger [A...Z] and [0...9]	0 or 1	1 if the trigger was activated, otherwise 0. Is only used in combination with manual analysis using the analysis software, see section 2.3.8 Defining the Triggers (for Manual Analysis).

Table 2-1: description of the journal data

\*The source of the co-ordinates for the individual parameters is in the top left corner of the each image (see Figure 2-4).

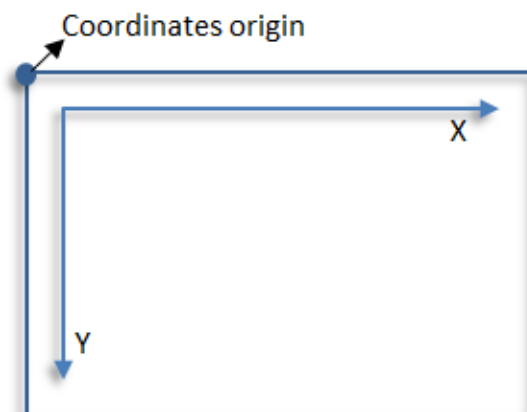


Figure 2-4: co-ordinate system

## 2.3 Working with the Dikablis Recorder

### 2.3.1 Starting the Recorder

The Dikablis recording software is already installed on your Dikablis computer. You can start the application via the Dikablis Recorder shortcut on the desktop or by selecting the corresponding entry in the computer's start menu. Please make sure that the Dikablis hardware and the license stick for the recording software are connected before executing the program.

**Note:** The Dikablis computer needs approx. 1 minute after booting up to initialize the hardware components needed for recording the eye tracking data. The application cannot be started during this period.

When the application is started, the recorder window is opened. The images from the field and eye cameras are shown in the preview window in blending mode. You can now continue configuring the settings needed to record the eye tracking data.

If an error warning is displayed when the program is started, it could be for the following reasons:

- The license stick is not connected.
- The system was not completely initialized. Close the application, wait one minute and then try again.
- The grabbers are not connected correctly. Close the application and check if the frame grabbers have been connected correctly to the computer. **Please do not unplug the grabbers while the Dikablis Recorder is running!**

If a different image to the one you anticipated is displayed in the preview window once the program has been started, please check the following:

- If a black image is displayed in the preview window, inspect the Dikablis hardware cabling and check to see if all of the devices have been turned on.
- If a gray image is displayed in the preview window, check the computer's audio settings. To do so, please proceed as described in chapter 3 FAQ.
- Check if the plugs for the field and eye cameras have been plugged into the wrong sockets and swap them over if necessary.

### 2.3.2 Configuration Display Options

The *LiveView* preview window allows the test subject's glance behavior to be monitored in real time. The current image area for the selected data source is always displayed in the window. You can select the displayed data source in the "*View Settings*", as shown in Figure 2-5. The following options are available for selection:

- "Fieldcam": displays the surroundings recorded by the test person (recorded by the field camera). The test person's current focal point is displayed by a cross-hair, see Figure 2-6 on the left.
- "Eyecam": visualizes the images taken by the eye camera, the center of the pupil is marked by a cross-hair, see Figure 2-6 in the middle.
- "Blending": a semi-transparent image from the eye camera is imposed over the image from the field camera, see Figure 2-6 on the right. This allows you to follow the results provided by the pupil detection feature. To do so, it is possible to determine which direction the test person is looking by following the pupil movement in the eye image. This is mainly important if the pupil was not detected automatically.
- The "blending factor" controller gives you the ability to change the transparency of the eye image. If you push the controller as far as possible to the left, the eye is completely transparent and you can only see the image from the field camera. If you push the controller to the right, the eye image completely covers the field image. Select a value in the middle control range to optimally superimpose the two images.
- To activate pupil detection, insert a tick in the check box beside "Eye Detection" (Figure 2-5). To deactivate pupil detection, remove the tick.

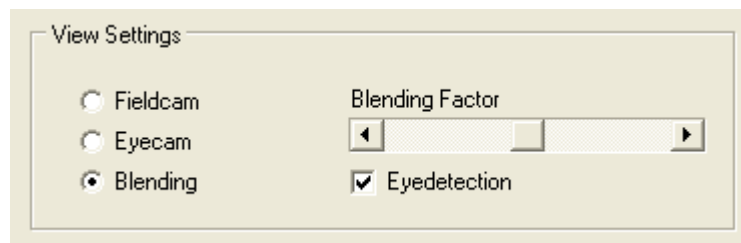


Figure 2-5: configuration of display options

To activate the full screen mode for the preview window, press the "Full screen" button. To exit the full screen mode, press the ESC button or use "Exit".

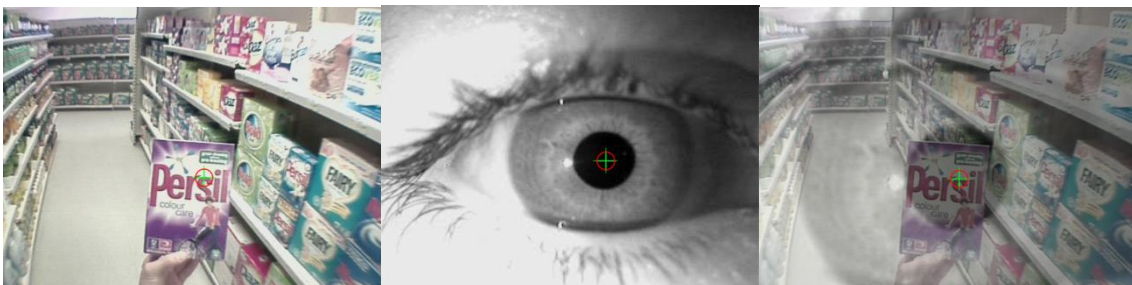


Figure 2-6: display of different data sources (field camera on the left, eye camera in the middle, blending mode on the right)

### 2.3.3 Creating a New Project

A project comprises a test series in which several subjects (corresponding to several test persons) can be performed. To provide clarity, please create a new project for every test series. To create a new project, please perform the following steps in sequence:

4. In the recorder's main window, select the menu item "*File*" and then the entry "*New Project*". Alternatively, you can press the button with the same name above the Live View.
5. The "*New Project*" dialog will open. This is explained with the aid of examples in Figure 2-7. You can enter information about your new project here. Please assign your project a fitting name so that you can easily identify it at a later date. It is imperative that you enter a name for the project. All of the other fields are optional.

**Note:** Please note that the project name must not include any special characters (\ / ; \* ? "< > |).

6. If you activate the project definition window in the "*create subject*" check box and then confirm the project dialog, a definition window will be immediately opened for the subject. You can then enter the data for the test person here (continue with section 2.3.5 Creating a Subject).
7. Once you have entered the required project information, click "*OK*" to create the project. You can cancel the process by simply pressing "*Cancel*".
8. After confirmation, the name of the current project is displayed in the title bar of the recorder. You can now create subjects.

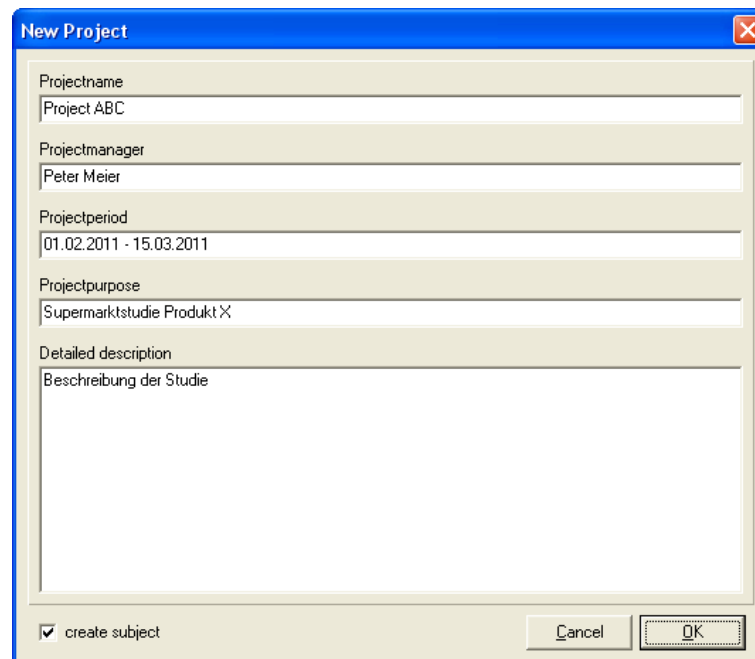


Figure 2-7: example of project definition

**Note:** Projects are saved under C:\ as standard. To change the location where you wish to save your project, follow the instructions included in section 2.3.7 Changing the Location where the Project is Saved.

### 2.3.4 Continuing an Existing Project

To continue working on an existing project, proceed as follows:

1. In the menu item "File", select the entry "Open". Alternatively, you can press the button with the same name above the Live View.
2. A window with a list of all of the available projects will appear, as shown in Figure 2-8. Select the project you wish to continue working on.
3. If you wish to subsequently create a subject, enter a tick next to "create subject" in the bottom section of the window (optional).
4. Confirm with "OK" to open the project or select "Cancel" to cancel the procedure.
5. After confirmation, the name of the open project is displayed in the title bar of the recorder. You can now create subjects.

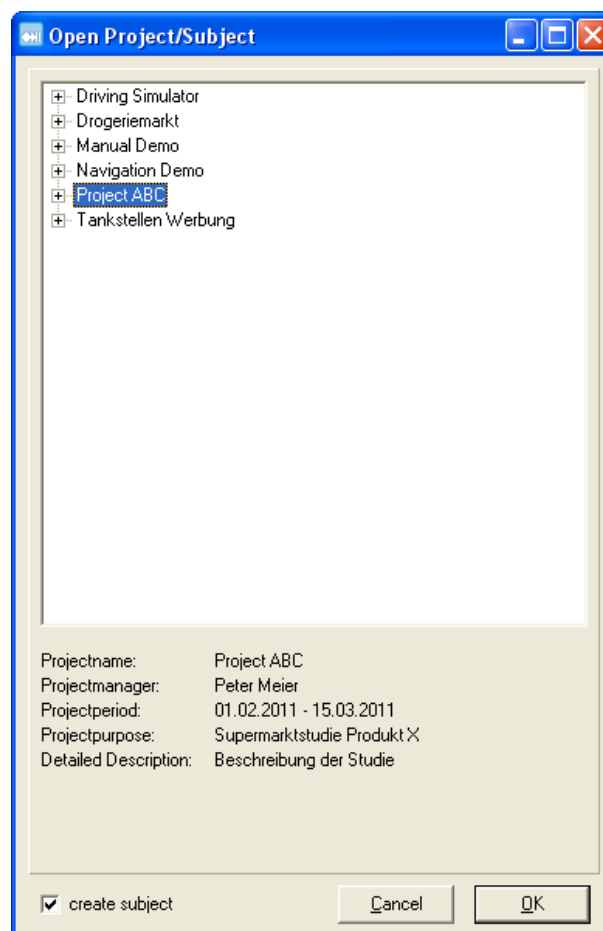


Figure 2-8: open project dialog

### 2.3.5 Creating a Subject

If you have created a new project or opened an existing one, you can generate several subjects in this project (to correspond to the number of test persons). For reasons of clarity and for an easier analysis, we advise you to generate a subject for each test person. To do so, proceed as follows:

1. In the "File" menu, select the entry "New subject". Alternatively, you can press the button with the same name above the Live View.
2. In the window which is now opened, you can fill in the information to describe the subject (see Figure 2-9). It is imperative that you enter a name for the project. All of the other information is optional. The subject name is the test person's designated name or code. Use this designation to clearly identify the test persons.

**Note:** Please note that the subject name must not include any special characters (\ / ; \* ? "< > |).

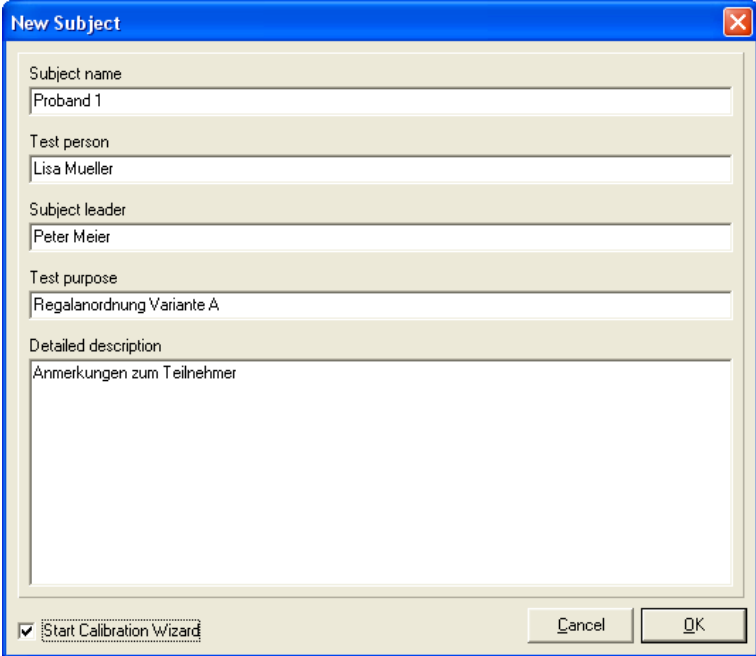


Figure 2-9: example of a subject definition

3. Confirm with "OK" to create the subject or select "Cancel" to cancel the procedure.
4. After confirmation, the designation for the current subject is displayed in addition to the name of the current project in the title bar of the recorder. The system is now ready to record data.



### 2.3.6 Continuing an Existing Subject

To continue working on an existing subject, proceed as follows:

1. In the menu item "File", select the entry "Open". Alternatively, you can press the button with the same name above the Live View.
2. A window with a list of all of the available projects and subjects will appear, as shown in Figure 2-10. Open up the project which contains the test person and select the subject which you would like to continue working on.
3. Confirm with "OK" to open the subject or select "Cancel" to cancel the procedure.
4. You can now record additional data for the subject.

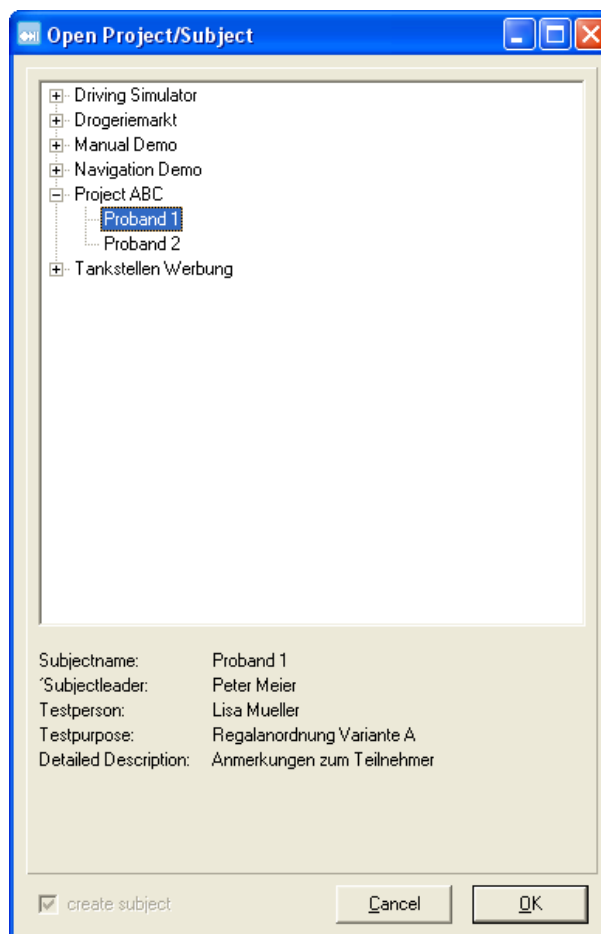


Figure 2-10: opening an existing subject

### 2.3.7 Changing the Location where the Project is Saved

The recorder's standard configuration saves projects on the C:\ drive. If you would like to change this storage location, please proceed as follows:

1. Close the application, select the *settings.xml* file from the "C:\Programme\Dikablis\Recorder" folder and open it.
2. The file includes the following location as its standard setting:  
<projectroot>c:\</projectroot>
3. To change the location for saving the project, replace the C:\ entry with your desired storage location, e. g. <projectroot>c:\My test data</projectroot>.
4. Save the changes in the *settings.xml* file and start the Dikablis recorder. Newly created projects will now be saved in the folder you have specified.

**Note:** As long as you work on a project and record new subjects, we would advise that you do not change the repository paths. Do not change the storage location until the project has been completed.

### 2.3.8 Defining the Triggers (for Manual Analysis)

**Note:** The triggers described in this section are suitable for the manual analysis of the eye tracking data. It is NOT possible to import these triggers in D-Lab. If you wish to analyze your data automatically with D-Lab, please do not use these triggers, but instead mark the individual and interval events using the D-Lab Control tool. For detailed information on this subject, please consult the D-Lab manual.

Triggers are saved for the specific project and can only be defined if a project has been created, but no subject is open.

#### General Outline

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Triggers are used to mark specific individual events or time intervals (e.g. carrying out a task) directly online while recording. There are two types of triggers available to do so:

1. *Single trigger*

The frequency of the event can be counted using the single trigger. If the single trigger is activated, it saves an individual entry in the journal file (see section 2.2.2) at the point in time when the activation took place.

2. *Interval trigger*

A time interval can be marked using the interval trigger. If the interval trigger is activated, entries are written into the journal file from the current point in time until the time when it is deactivated again. Should you need to adjust the pupil detection feature retroactively, e.g. because you need to record outside, you can use the interval trigger (or indeed the single trigger) to later jump to precisely this position.

If a new trigger is defined, an additional column is generated in the journal file. The column is named after the key which activates the trigger. If a trigger is activated (either by pressing a key or by a network command), a new entry is generated in the journal file at the time of the activation. Single triggers generate a single entry "1" in the respective column at the time of activation. All other

entries in this trigger column are set to "0". An interval trigger writes a "1" into the corresponding column as long as the trigger is active. If the trigger is deactivated by pressing the respective key on the keyboard, a "0" is written once again in the corresponding column. At times when a trigger is not active, or is switched off, "0" is always written into the respective column.

You can find a check-back signal for every trigger which has been set in the "received network events and triggers" area of the recorder window.

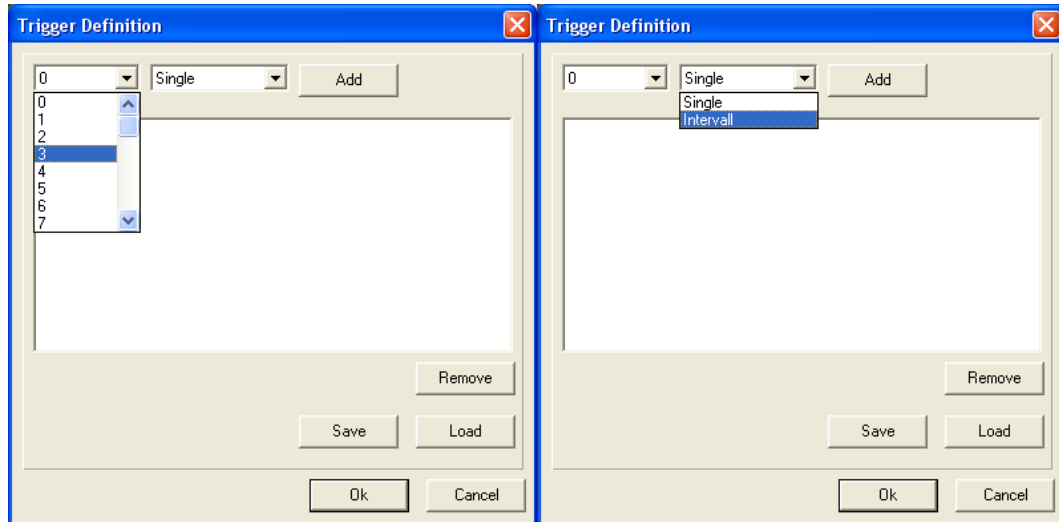


Figure 2-11: trigger type and key assignment

### Trigger Definition

Important: You must define the triggers before creating a new subject as they are defined for an entire project.

1. In the menu item "Settings", select the entry "*Trigger Definition*".
2. A window for defining the triggers is opened. Assign an activation key on the keyboard to the trigger in the left selection field (Figure 2-11, on the left). The keys A-Z and the numbers 0-9 are permitted. In the right selection field, please select the trigger type: single or interval trigger (Figure 2-11, on the right).
3. Click "*Add*" to assign the trigger definition to you current project. Your newly defined trigger will now appear in the bottom area of the window (Figure 2-12).
4. Click "*OK*" to activate the triggers.
5. If you close the project, the triggers will be deleted. In order to prevent this from happening, click "*Save*" so that you can use the triggers in future projects. Saving generates an XML-file which contains the trigger definitions and can be loaded into every project.

### Deleting Triggers

Should you wish to delete a trigger, select the trigger in question in the list and click "*Remove*" to delete it (see Figure 2-12).

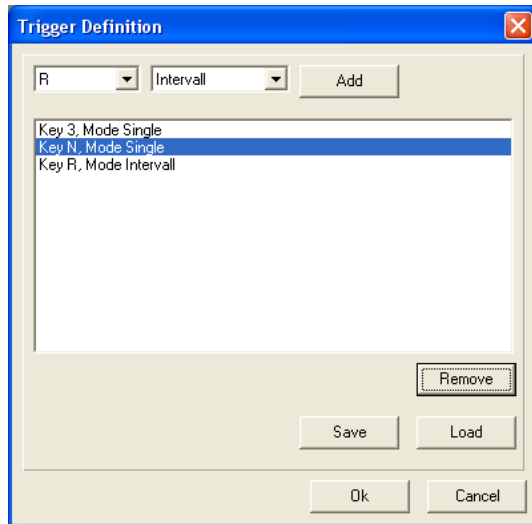


Figure 2-12: deleting a trigger

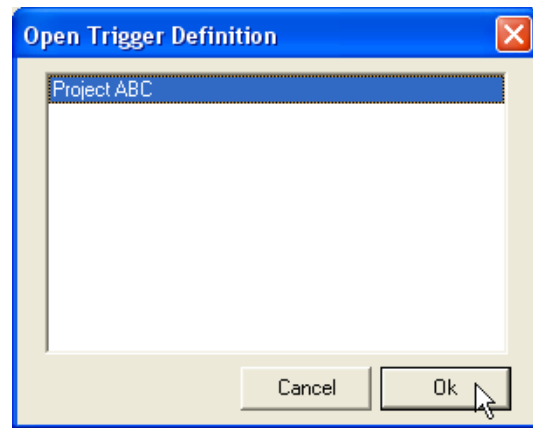


Figure 2-13: importing saved triggers

### Importing Triggers

If you have already defined triggers in another project, you can import them into your current project:

1. Click "Load" in the "Trigger" definition window.
2. The window "Open Trigger Definition" will now appear.
3. Select the project from which you wish to import the trigger definitions (see Figure 2-13).
4. Click "OK" to import the trigger definitions. The "Open Trigger Definition" window closes.
5. The "Trigger Definition" window will now display the imported triggers. Click "OK" to activate the triggers.

### 2.3.9 Putting on the Head Unit

To guarantee that your tests run perfectly, it is important that the head unit sits properly on the head of the test person and that the camera views are adjusted correctly. To adjust the cameras, the recording computer must be turned on and the recording software must be running.

To optimally adjust the head unit to fit the head of the test person in question, please observe the following instructions:

1. To put on the head unit, grip the head band (drawstring) with one hand and the head support with the other hand. Position the nose support on the bridge of the test person's nose as if putting on normal eye glasses and pull the head band over his/her head so that the head support is resting against the forehead. Figure 2-14 shows an example of a correctly worn head unit.
2. Then tighten the head band with the drawstring, by adjusting it to the required length. The equipment must never be adjusted so tightly that it causes discomfort or leaves skin indentations. We have gone to great pains to provide the head unit with an ergonomic

design, so that the test can be as easy and comfortable as possible. Thanks to its light weight and ergonomic design, the test person's degree of abstraction from the real world is minimized and the head unit is as comfortable as possible to wear.



Figure 2-14: head unit



Figure 2-15: head unit, person wearing glasses

Note: Dikablis can also be used if the test person wears glasses or contact lenses. If glasses are worn, position the head unit over the glasses, as shown in Figure 2-15.

### 2.3.10 Adjusting the Eye Camera

In the recorder's main window, select the display option item "EyeCam". This will allow you to view the image from the eye camera in the preview window in its original resolution.

The eye camera now needs to be adjusted so that the eye is in the middle of the image. The eye should be as horizontal as possible and the picture must be sharp. The lens of the eye camera is designed so that the image of the eye has the correct sharpness at the optimal distance between the eye camera and the eye. This also ensures that the eye has the correct size in relation to the eye camera image.

The eye camera is attached to a flexible swan-neck cable. This type of attachment allows the camera to be moved easily (both vertically and horizontally) and turned in front of the eye (compare to Figure 2-16). The position of the eye camera can be adjusted with the aid of horizontal, vertical and rotational adjustment features. The result is as shown in Figure 2-17.

**Note:** The eye camera is suitable for recording an image of the left eye. Please do not try to bend the camera to the right eye as this can lead to the head unit being damaged and no longer suitable for use!

The following section describes the steps needed to optimize the adjustment of the eye camera. Here we will illustrate how to adjust a completely improper setting until the desired result is achieved, as illustrated in Figure 2-17.



Figure 2-16: adjusting the eye camera

### *Initial Situation*

---

The initial situation is shown in Figure 2-18. This setting is incorrect for the following reasons:

- The camera is too close to the eye
- The eye is at a slant (not horizontal) in the image
- The camera is too far to one side
- The eye is too far up

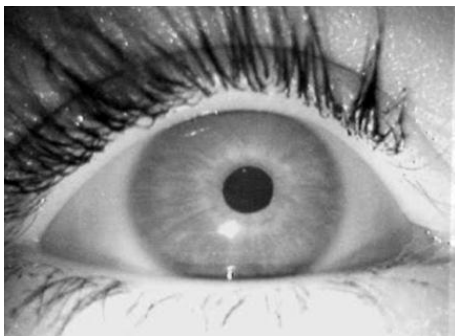


Figure 2-17: optimal position of the eye



Figure 2-18: situation before starting adjustment: camera too near to the eye, eye at a slant in the image, camera too far to the side, eye too far up

### *Adjusting the Distance between the Eye Camera and the Eye*

---

You can adjust the distance between the eye and the eye camera by moving the eye camera towards or away from the eye. You can tell when you have reached the correct distance as the eye camera image will become sharp, as can be seen in Figure 2-19.

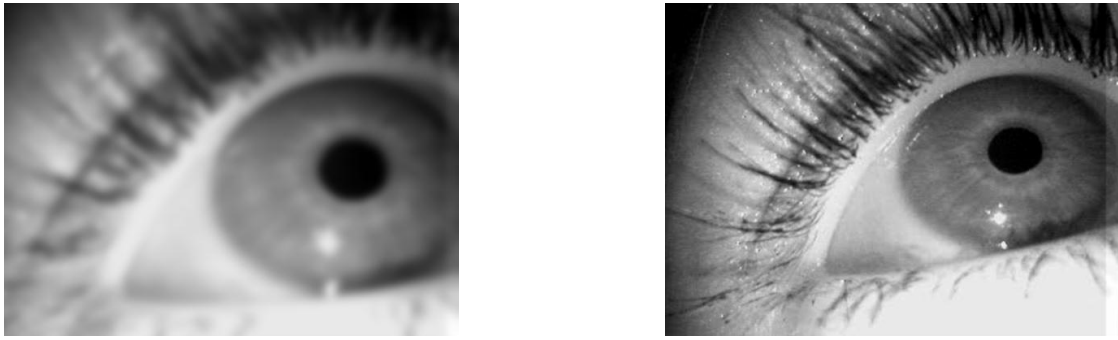


Figure 2-19: adjusting the distance (before and after)

### ***Adjusting the Tilt of the Eye within the Eye Camera Image***

---

As can be seen in Figure 2-20, on the left, the eye is at a slant in the eye camera image. This can be rectified by turning the eye camera to the correct position. Figure 2-20 on the right shows the correct setting. The eye is horizontal in this image.

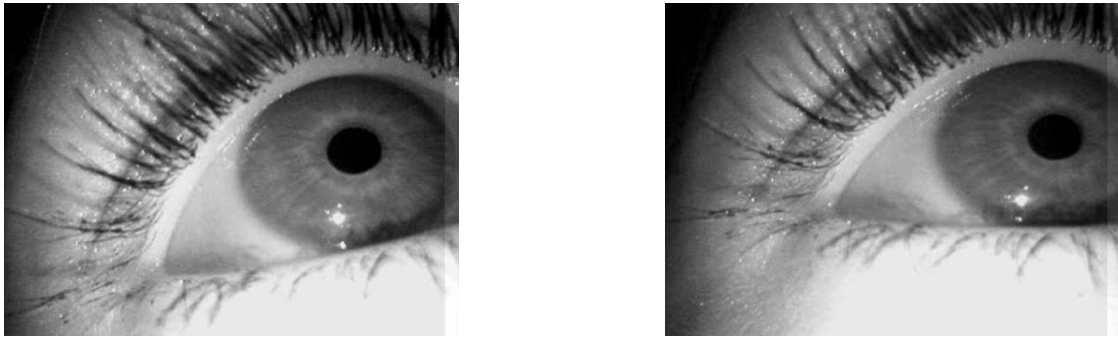


Figure 2-20: adjusting the tilt (before and after)

### ***Adjusting the Horizontal Position of the Eye in the Eye Camera Image***

---

As can be seen in Figure 2-21 (left), the eye is positioned too far to the right in the eye camera image, meaning it cannot be permanently detected by the camera. Move the camera to the right or to the left in front of the eye to adjust the horizontal position of the eye in the eye camera image. Figure 2-21 on the right shows the horizontal position once the adjustment has been made.

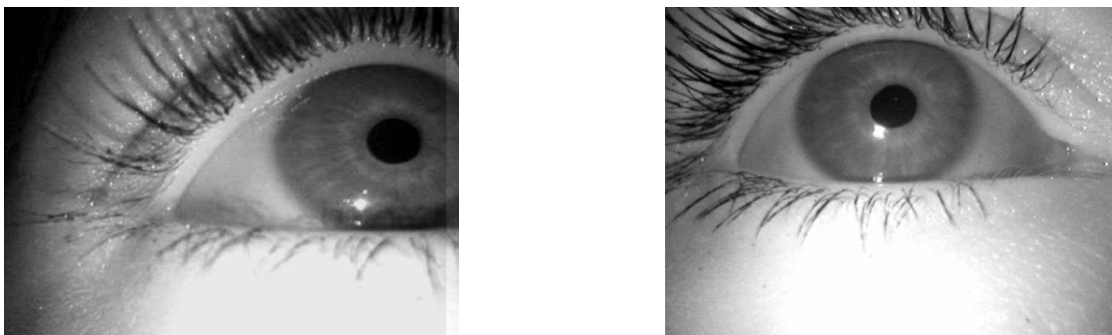


Figure 2-21: horizontal position adjustment (before and after)

### ***Adjusting the Vertical Position of the Eye in the Eye Camera Image***

---

The last step is the correct vertical adjustment of the eye in the eye camera image. To do so, move the camera upwards or downwards in front of the eye. As can be seen in Figure 2-22 on the left, the eye is positioned too far up the eye camera image. The correct vertical adjustment can be achieved by tilting the eye camera slightly downwards, as shown in Figure 2-22 on the right.

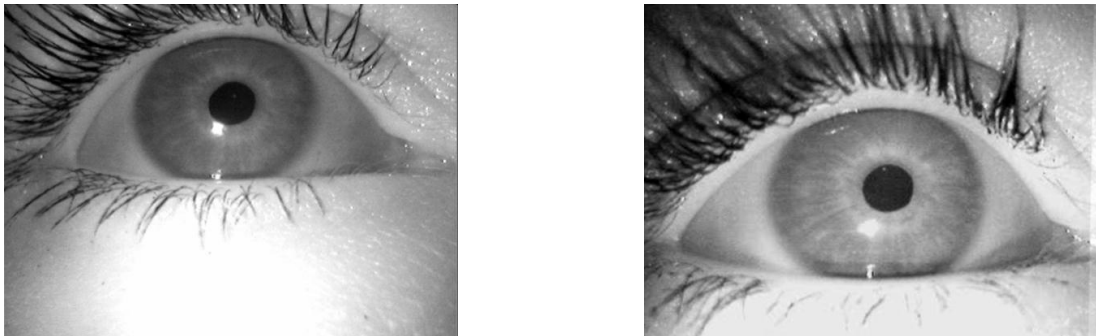


Figure 2-22: vertical position adjustment (before and after)

### *The Position of the Eye Camera in relation to the Eye*

---

The vertical position of the eye camera in front of the eye can be varied in a wide range using the swan-neck. Figure 2-23 shows two different vertical positions of the eye camera in front of the eye. In the left picture, the eye camera is directed straight to the eye from the front. Figure 2-23 on the right shows the eye camera pointing towards the eye from a lower position.

To achieve fixation points with optimal accuracy, we recommend pointing the eye camera straight at the eye, from exactly in front of it if possible, as demonstrated in Figure 2-23 on the left. If the test person has long eyelashes which partly cover the pupil if the eye camera is directed straight at the eye, then the eye camera should be adjusted to the position shown in Figure 2-23 on the right. This way, the eye is filmed from a lower position and thus films below, and thus past, the disruptive eyelashes. To reduce the impact of the eyelashes on the pupil detection feature, we recommend the use of the masking options in the pupil detection settings (compare 2.3.13 Pupil Detection Configuration).





Figure 2-23: vertical position of the eye camera in relation to the eye

### ***Illuminating the Eye Using the Infrared LED***

---

To guarantee ideal pupil detection in the eye camera image, the eye must be illuminated properly with the infrared LED. To do so, the intensity of the illumination can be adjusted at the cable box (see the Dikablis Cable section of the Dikablis Hardware manual) and/or at the transmitter (see the Dikablis Wireless section of the Dikablis Hardware manual). In poor lighting conditions, more intense infrared illumination will be required than in very bright conditions.

#### **2.3.11 Adjusting the Field Camera**

The field camera is pointing forward and "sees" what the test person sees. Open the recording software and select "*FieldCam*" as the display source. Now analyze the view of the field camera in the preview window. If the environment to be examined is displayed incorrectly, you will have to adjust the field camera accordingly. To do so, loosen the adjustment screw for vertically positioning the field camera (horizontal adjustment is not necessary) and move the camera to the required position by turning it up or downward (see Figure 2-24). Please make sure that the test person assumes the same position he/she would have during the test. Once the field camera has been adjusted correctly, lock it in position by retightening the above-mentioned screw.



Figure 2-24: adjusting the field camera



Figure 2-25: adjusting the lens

You can also change the field camera's field of view by replacing the camera lens. The standard focal distance of the camera is 2.1mm (this correlates to an aperture angle of about 100°). Other lenses can be purchased from us (see the "Head Unit" section in the Dikablis Hardware manual).

The focus of the field camera can be adjusted by turning the lens, as shown in Figure 2-25. Particularly if you wish to use the D-Lab automated analysis function, you should make sure that the D-Lab markers used can be seen clearly in the image (for information on how to apply the markers properly, please consult the D-Lab manual).

If you also ordered the filter package (only needed if you have a color field camera and record your tests in areas with very bright lighting conditions), you can use it to adjust the aperture manually. To change the brightness, turn the two polarization filters on the field camera lens in opposite directions.

### 2.3.12 Using the Calibration Assistant

You can start the calibration assistant by pressing the "*Calibration Wizard*" button. In several steps, it will support you in finding the optimum position for the eye camera, setting the parameters for pupil detection and will guide you through the calibration process. Start the assistant and follow the instructions in the following chapters.

**Note:** Check the position of the field camera before calibration, as described in section 2.3.11 Adjusting the Field Camera. If you change the position of the field camera after calibration you will have to recalibrate.

#### 2.3.12.1 Step 1: Adjusting the Eye Camera

The first window of the calibration assistant (Figure 2-26) will help you adjust the eye camera. In the area on the left, you can see the eye camera image superimposed with vertical and horizontal guide lines. Position the camera so that the pupil is in the center of the image for as long as possible (in the area where the guide lines cross). When doing so, make sure that the eye is not at a slant in the image. A detailed description of how to position the eye camera including examples can be found in section 2.3.10 Adjusting the Eye Camera.

In the right area of the window there are three examples of images. The first shows an image taken from an optimally positioned eye camera, the second shows a poor example of a camera positioned at a slant and the third also shows a poor example in which only half an eye is visible in the image.

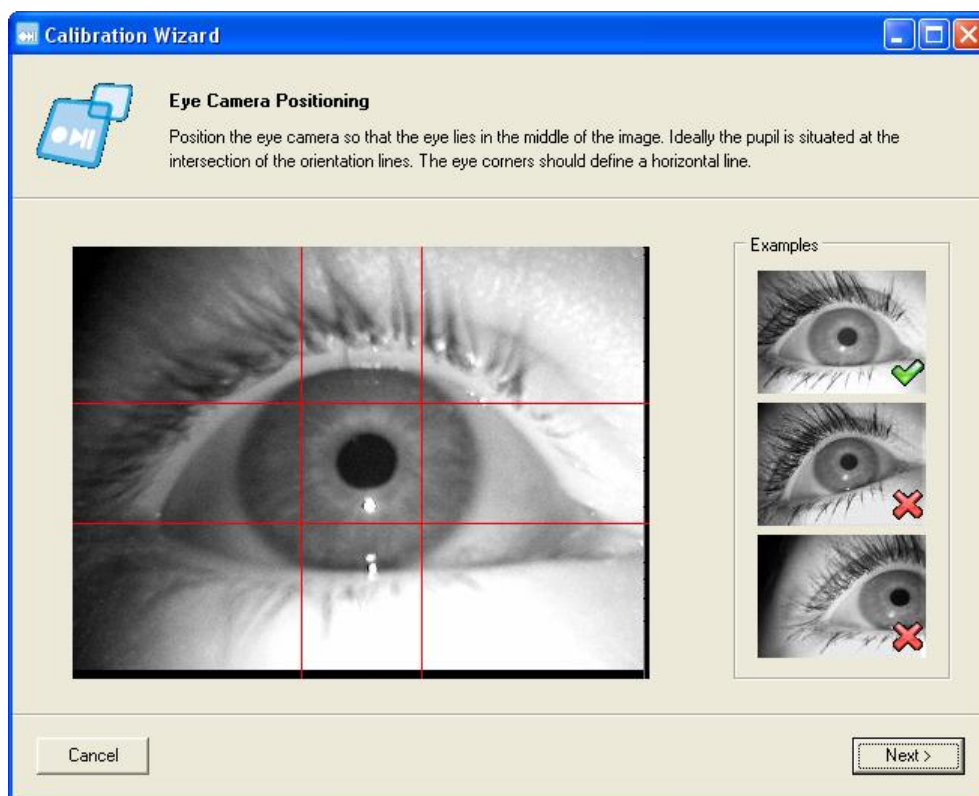


Figure 2-26: calibration assistant - positioning the eye camera

Once the eye is optimally visible, press "Next" to reach the next step in the configuration or select "Cancel" to cancel the procedure.

### 2.3.12.2 Step 2: Pupil Detection Configuration

In the next step, you can optimize pupil detection. Two basic options are available for this, as shown in Figure 2-27.

- *Masking settings:* Here it is possible to limit the area in which the pupil is to be detected. This function is very useful for removing any areas of the image which may interfere (e.g. dark eyelashes, makeup, glasses frame). You can set the mask by moving the scrollbars at the left and above the eye image so that only the relevant section of the image remains, as shown in Figure 2-27.
- *Isolate pupil:* Separates the pupil from the rest of the image by setting a threshold value. The threshold value can be adjusted by moving the scrollbar in the right part of the window. A histogram of the eye image can be found below the scrollbar. The result of the pupil detection in the left preview window (image areas marked in red) will change according to the limits you set. The optimal setting is shown in Figure 2-35. The green circle represents the computed position of the pupil. If the circle can no longer be seen, the pupil cannot be detected.

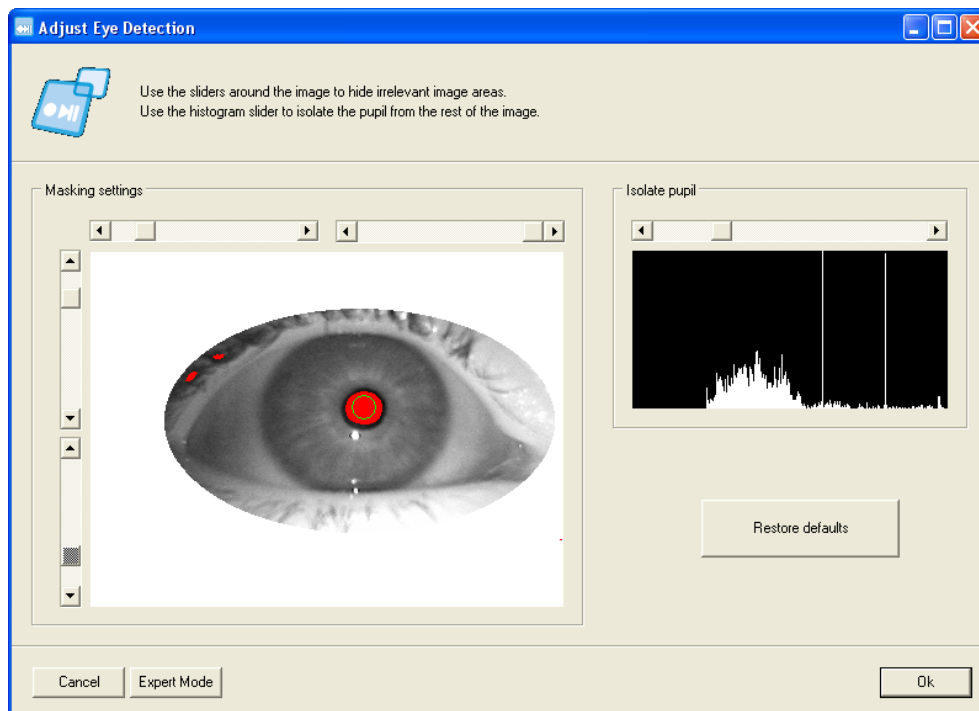


Figure 2-27: calibration assistant - pupil detection configuration

By pressing "Restore defaults", you can reverse all of the changes you made and return the system to its original configuration.

The "Expert Mode" button allows you to reach an advanced configuration dialog for pupil detection. It is only suitable for experienced user and is described in detail in the section 2.3.13 Pupil Detection Configuration - Expert Mode.

Then test your settings:

- Ask the test person to look left, right, up and down without moving their head.
- Monitor the pupil detection function. Try to find out if and when the pupil is no longer detected.
- If needed, optimize your pupil detection settings, as explained above, until you have found an ideal setting.

***Please note:***

- The following applies for the pupil detection feature: the better and more precise the settings, the easier and more precise the later analysis will be. You can use the analysis software to adjust the pupil detection or optimize the detection rate after the test, but this will always involve additional work.
- Another method for optimizing the image if it contains disruptive eyelashes or hanging eyelids is to adjust the position of the eye camera to film the eye from a below at a slight tilt.

It is also possible to adjust pupil detection outside of the calibration assistant. You can reach the same dialog from the recorder user interface by pressing the "*Adjust Eye Detection*" button. The settings for detecting the pupil are automatically saved when the application is closed and restored when the recorder is opened once again.

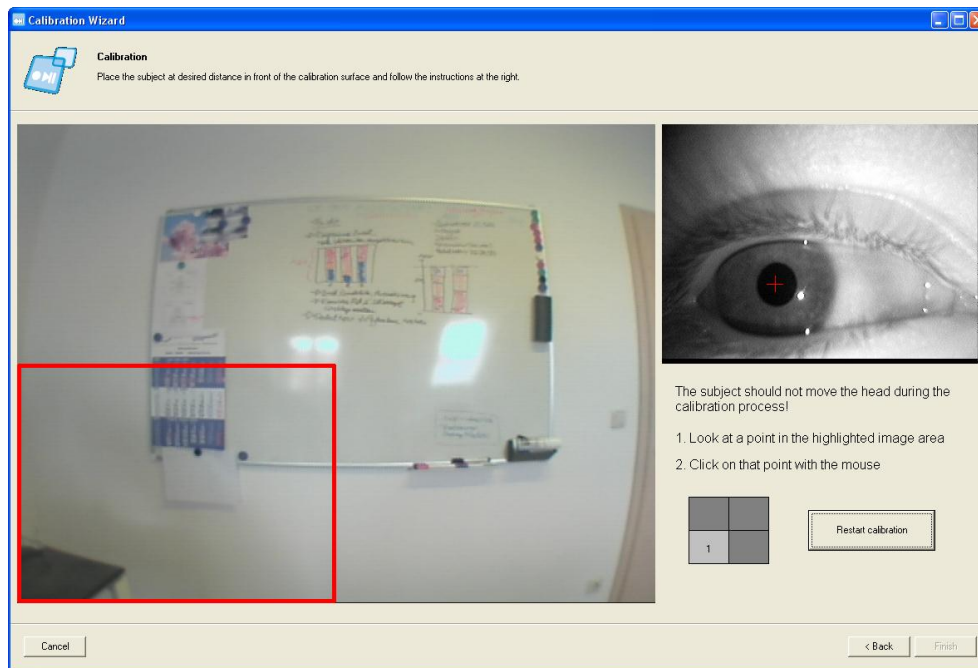
### ***2.3.12.3 Step 3: Calibration***

Once the first two steps of positioning the eye camera and configuring the pupil detection feature have been completed, the eye motion needs to be calibrated. When doing so, observe the following:

- To calibrate, the test person must look at four points, one in each quadrant of the field camera image.
- Position the person to be calibrated in front of the object of calibration (a wall with markings, a shelf in a supermarket, the driver's seat in a vehicle, etc.). The distance between the test person and calibration object should be as close as possible to the actual distance from the relevant image plane used during the study. In the example shown, the test person is calibrated while standing in front of a whiteboard (Figure 2-28).
- The test person should hold his/her head as still as possible during calibration.
- Select four points in the surroundings which are also visible in the field camera image. Make sure that each point is in a different image quadrant. The sequence in which the points need to be viewed is clockwise, starting with the bottom left quadrant and then followed by the top left, top right and finally the bottom right quadrant. The four corners of the whiteboard were selected as the calibration points in the following example.

To calibrate the test person, proceed as follows:

1. Instruct the test person that he or she should keep his or her head as still as possible.
2. The person should look at the selected calibration point in the top left quadrant, as shown in Figure 2-28. The point must be located in the image area marked with a red rectangle.
3. In the top right of the calibration window you can see the eye camera with the result of the pupil detection. You can check here if the pupil was detected correctly. If not, go back one step and adjust the settings. You will only receive the correct calibration of the pupil is optimally detected for all four calibration points.



**Figure 2-28: calibration assistant - calibration step 1**

4. While the test person is looking at the point, use your mouse to click on the corresponding area in the field camera image. The selected image point is marked with a circle, as shown in Figure 2-29.
5. Instruct the test person to look at the second calibration point in the top left quadrant (Figure 2-29).
6. While the test person is doing this, use your mouse to click on the corresponding area in the field camera image. This point is also marked (Figure 2-30).

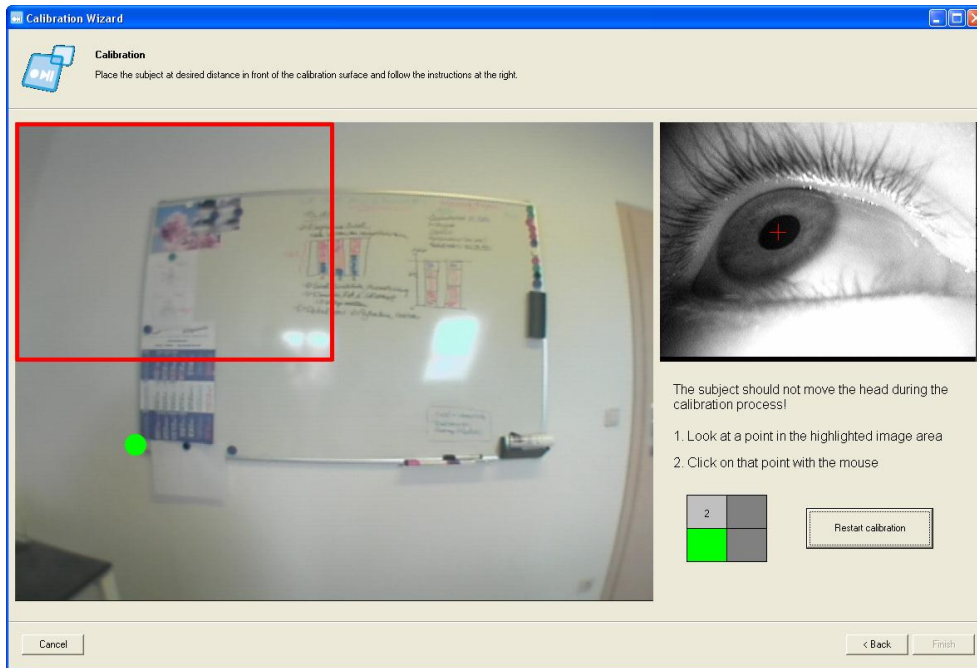


Figure 2-29: calibration assistant - calibration step 2

7. Make the test person look at the calibration point in the top right area of the image and again mark the point being looked at (Figure 2-31).

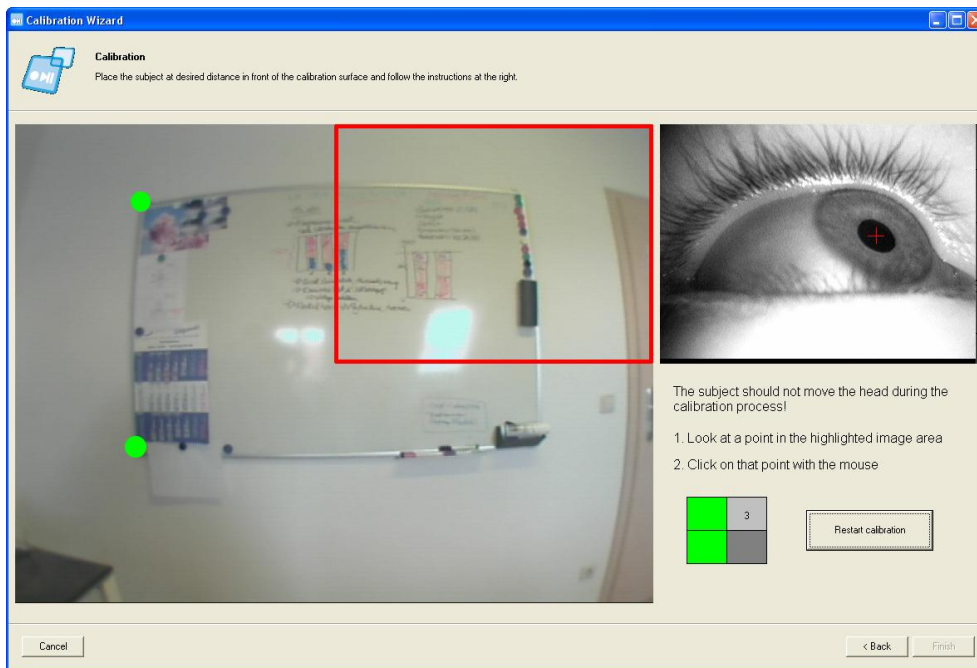


Figure 2-30: calibration assistant - calibration step 3

8. Then instruct the person to look at the calibration point in the bottom right quadrant (Figure 2-31) and mark this point with a mouse click.
9. Once all of the four points have been marked correctly, the system will automatically calibrate itself in the background and will display the calibrated eye motion (Figure 2-32). The test person may now move his/her head once again and you can check the calibration. If you are happy with the result, press the "Finish" button to end the assistant. If not, you can repeat the calibration by pressing the "Restart calibration" button.

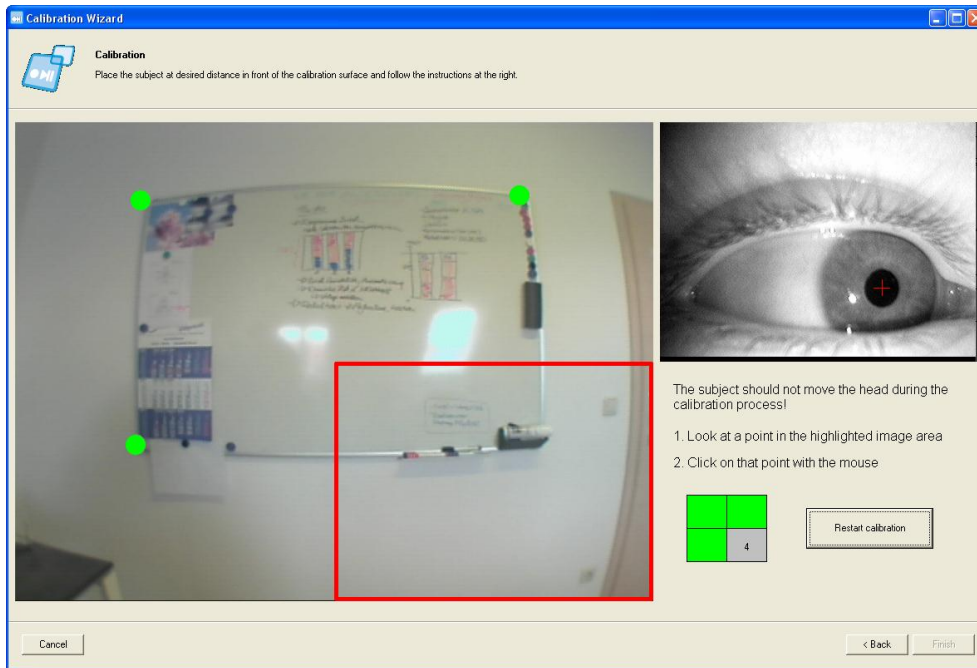


Figure 2-31: calibration assistant - calibration step 4

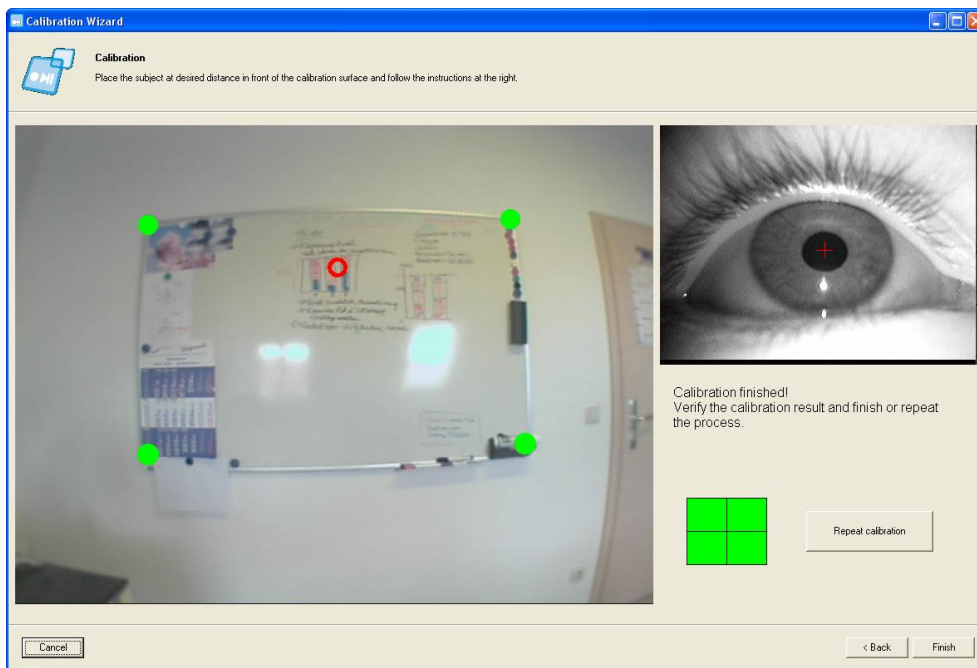


Figure 2-32: calibration assistant - checking the results

Please note that the order of the calibration points must be observed and that the point to be calibrated must always be in the image area which is currently active (within the red rectangle). If this is not the case, an acoustic warning will be signaled and a corresponding fault message will be displayed in the bottom area of the window (Figure 2-33). The calibration point will also not be accepted if the pupil marking has not been detected. In this case, an acoustic warning and a fault message will be output (Figure 2-34).



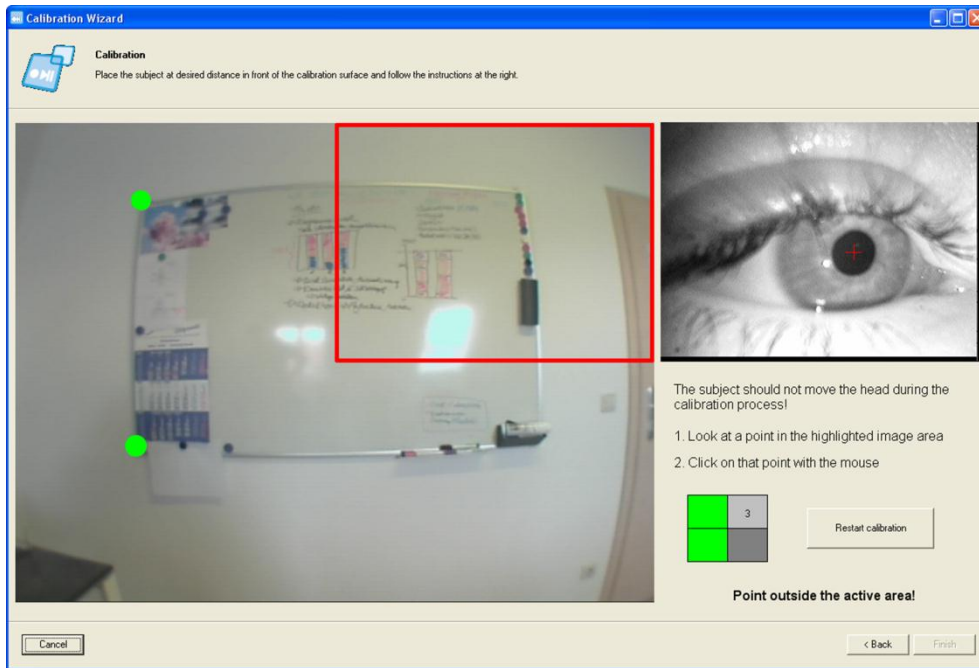


Figure 2-33: calibration assistant - calibration point not in the active image area

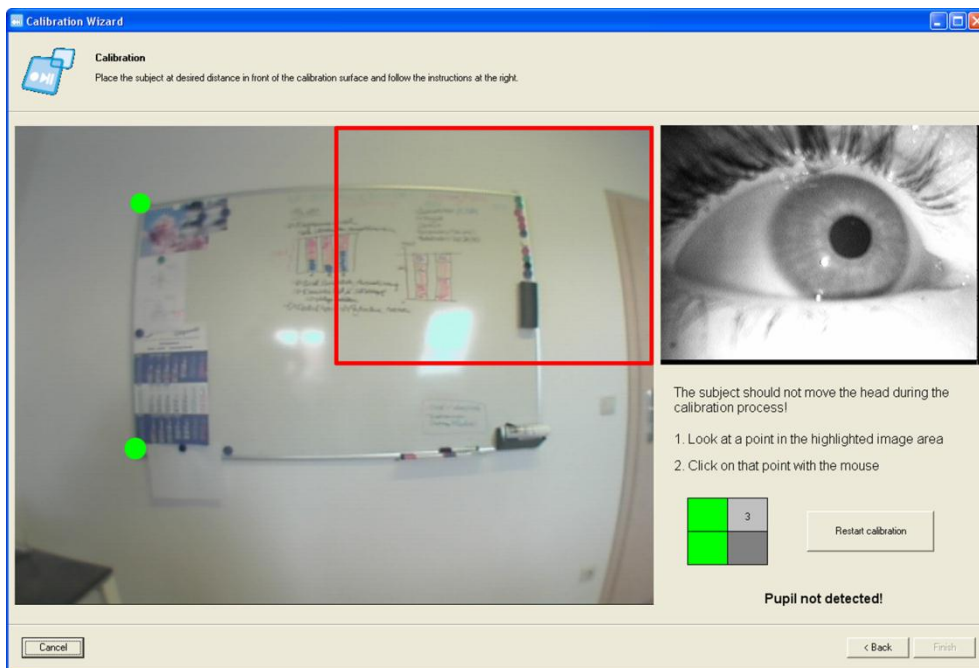


Figure 2-34: calibration assistant - pupil was not detected

### 2.3.13 Pupil Detection Configuration - Expert Mode

Before you start configuring the pupil detection feature, please make sure that the eye camera is positioned correctly. If this is not the case, please adjust the eye camera and field camera first. To do so, follow the directions given in sections 2.3.10 and 2.3.11.

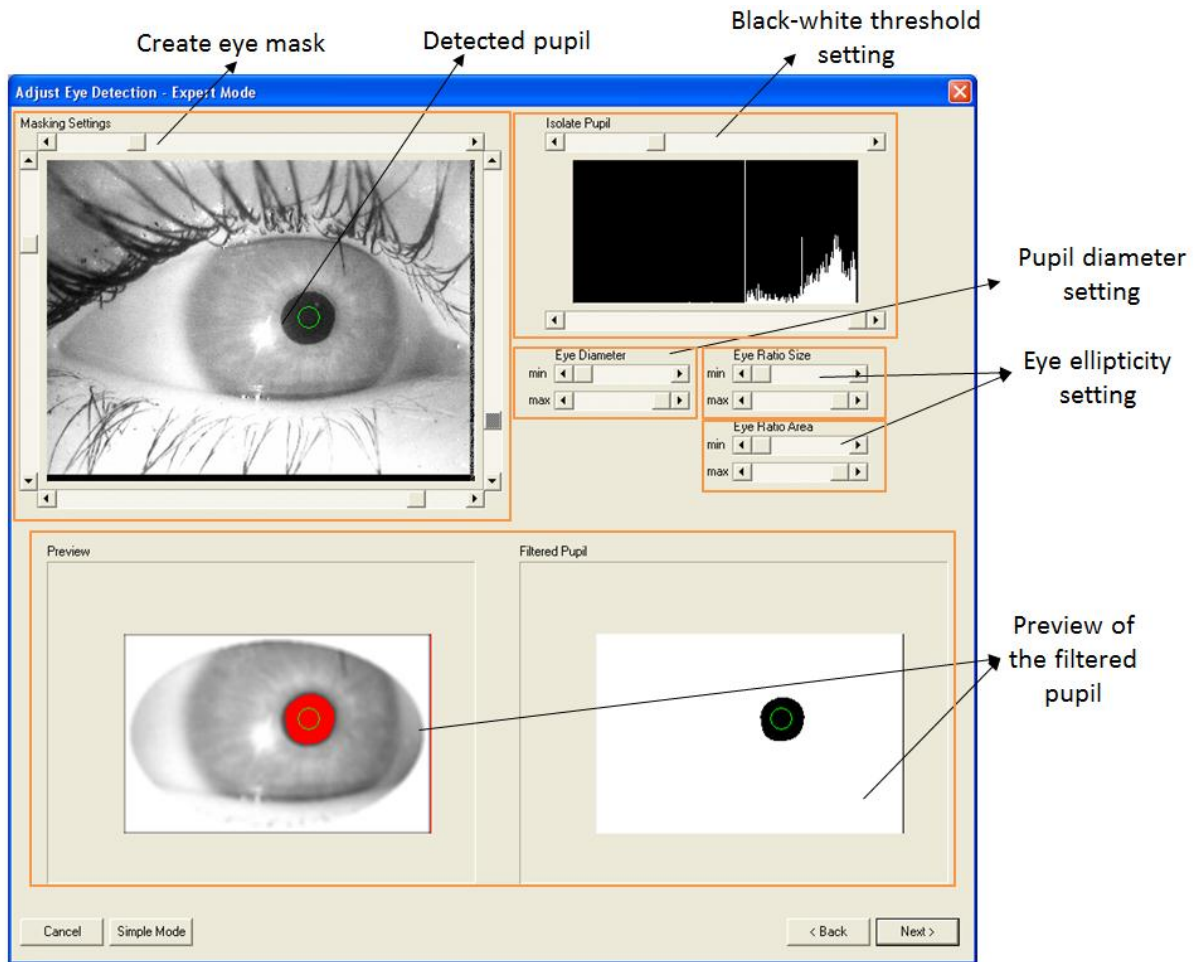
The more precisely you configure the pupil detection, the easier it will be to analyze the eye tracking data later on. So please check your settings precisely once again. Furthermore, the eye will also need to be optimally illuminated for this task so recheck your settings! (See section 2.3.11).

To activate pupil detection, insert a tick in the check box beside "*Eye Detection*" (Figure 2-5). To deactivate pupil detection, remove the tick.

The dialog for pupil configuration is available in a simple version (*Simple Mode*, see 2.3.12.2) and in an expert version (*Expert Mode*). We will be describing the expert version here. You can switch between the two modes by pressing the "*Simple Mode*" (Figure 2-35) and "*Expert Mode*" (Figure 2-27) buttons.

You can reach the pupil configuration feature either via the calibration assistant or directly from the recording user interface via the "*Adjust Eye Detection*" button. Open the configuration dialog in the expert mode (Figure 2-35) and follow these instructions:

1. To localize the pupil in the eye camera image, proceed as follows:
  - *Segment the pupil by setting the black/white threshold value:* To set the pupil detection limit between black and white, use the top right "*Isolate Pupil*" scroll bar. The histogram is in the top right corner of the adjustment window, below the scroll bar. The filtered picture of the pupil in the preview window (bottom window area) will change according to the limits you set. The optimal setting is shown in Figure 2-35. The green circle represents the computed position of the pupil. If the circle can no longer be seen, the pupil cannot be detected. The controller underneath the histogram allows the gray-scale area of the eye camera image to be limited and is only suitable for experienced users. For most applications, the pupil should be detected well if you move this controller as far as possible to the right.
  - *Adjusting the eye mask:* In the top left corner of the calibration window, you will find the "*Masking Settings*" adjustment area. Here it is possible to limit the area in which the pupil is to be detected. This function is very useful if other black objects are detected following segmentation (e.g. dark eyelashes, makeup, glasses frame), as shown in Figure 2-35 for example. These objects can be excluded by setting the mask so that detected faults can be avoided. You can set the mask by moving the scrollbars to the left/right, up/down so that only the relevant section of the image remains, as shown in Figure 2-35.
2. After segmentation, a range of search criteria is applied to the remaining black objects (ideally only the black, round pupil). These criteria must be met in order for a spot to be classified as the pupil. The search criteria can be set in the calibration window. However, we recommend that only experienced users change the standard settings. You can achieve good results if the controller incorporates the entire value range.
  - In the "*Eye Diameter*" area, you can set the minimum and maximum pupil diameter so that a round object can be classified as a pupil.
  - The pupil is only a circle in the eye camera image if the test person is looking straight ahead. If the test person is looking to the left or right, the shape of the pupil will change to an ellipse. With the scrollbars "*Eye ratio size*" and "*Eye ratio area control*" you can define how elliptical a black spot may be for it still to be detected as the pupil.



**Figure 2-35: pupil detection adjustment in expert mode**

Now test your settings and have your test person look upward/downward, to the left/right. If necessary, optimize your parameters.

Your pupil detection is now configured. Click the "OK" button to complete the process (or the "Next" button in the calibration assistant).

### 2.3.14 Manual Calibration

Once the eye camera and the pupil detection have been configured, the next step is to calibrate the eye tracking system. To do so, you can use the calibration assistant (chapter 2.3.12.3) or perform manual calibration as described here.

During the calibration process, the correlation of the images from the eye camera and field camera (position settings), and the plane of calibration (distance settings) are adjusted. The glance behavior is always calibrated at one particular plane and at a constant distance away from the eye. The system works very accurately at this plane. If the test person is looking at objects not included in this plane, the accuracy decreases. Calibration based on the plane of analysis is sufficient for the majority of applications.

If the glance behavior towards two planes located further away from one another is relevant, it is possible to perform a test with the analysis software and then calibrate to another plane. This allows

several planes to be calibrated with great precision (e.g. vehicle: vehicle interior (one plane) and traffic signs (the second plane)).

The calibration field is visible in the top part of the recorder window, as shown in Figure 2-2. The functions of this area are explained in Figure 2-36.

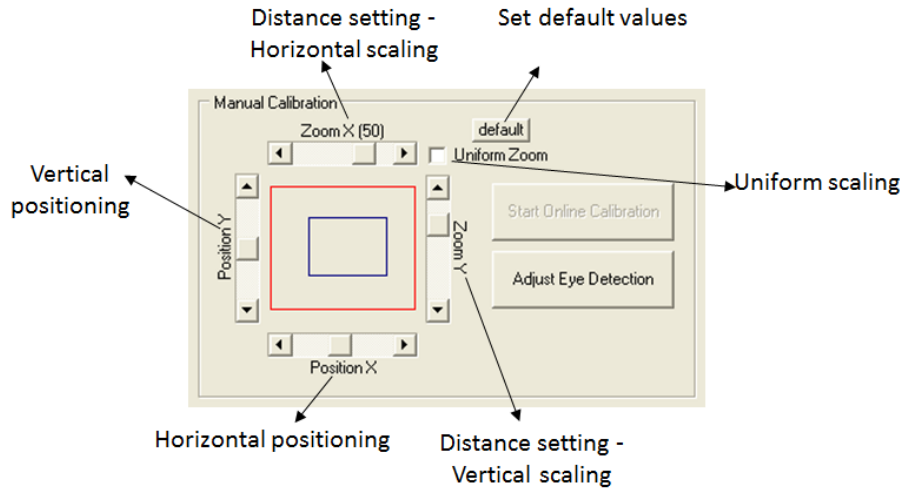


Figure 2-36: functions of the calibration area

In this section, the distance and position settings are briefly explained. The calibration procedure is then subsequently explained in a step-by-step manner with the aid of examples.

- *Position settings*

Use the scrollbars (as illustrated in Figure 2-36) to adjust the vertical and horizontal position of the cross-hair. The cross-hair symbolizes the viewing direction of the test person on the preview screen. The two controllers can be used to shift the image from the eye camera over the image from the field camera - the latter remains in a fixed position.

- *Distance settings*

By using the distance settings, the distance between the eye and the plane of analysis is adjusted. The distance away from plane of analysis has an effect on the scaling factor of the eye image. The closer the plane, the greater the eye image is scaled. The separate horizontal and vertical scaling allows very precise calibration to be achieved.

The eye camera image can be horizontally and vertically scaled using distance controllers. If symmetrical scaling has been ticked, the image is scaled uniformly in both directions. If not, it is possible to scale separately in the horizontal and vertical directions.

As already mentioned, the system is always calibrated to a one single plane at a fixed distance away from the eye. The system works very accurately at this plane. If the test person is looking at objects not included in this plane, the accuracy decreases.

- *Retrieving the Default Settings*

You can retrieve the standard values for calibration by pressing the "default" button. This is useful if you would like to calibrate a new test person or if you have calibrated incorrectly.

The calibration settings are automatically saved when the application is closed and restored when the recorder is opened once again.

### Calibration Sequence

---

You will require two people for calibration. One test person must wear the head unit and the other must carry out the calibration. To calibrate the eye tracking system, you must first of all select three "calibration points" according to the following criteria:

- The points must be on the same plane (e.g. on a monitor or a wall).
- The points must be at the same distance, one which is also relevant for your test. You will get the best results if you choose points which are also relevant for the later analysis.
- The points should be distributed in a way which will allow the system to be calibrated both horizontally and vertically. To achieve this, the points must be in an "L" pattern, with one edge pointing in a horizontal and the other in a vertical direction, as shown in Figure 2-37. The middle point should be selected so that the test person can look directly at this point when holding his/her head straight and looking forward.
- Please note that the distance between the points should not be too great. The angle of vision between the points should not be greater than 45°. If is greater, test persons will tend to turn their head and not just their eyes, something which should be avoided during calibration.

To calibrate Dikablis in front of a monitor, the best thing to do is to choose a point in the middle of the monitor, one at the right edge (if possible, half way between the top and bottom edges) and a point at the top edge (as close as possible to the middle between the left and right edges). If you would like to use a fourth calibration point, we recommend choosing one of the four corners of the monitor as this would help check both the horizontal and vertical calibration (see Figure 2-37).

This section describes the calibration in front of a computer screen step by step. The process is shown as a flow chart in Figure 2-38. ***Please remind the test person to move his/her head as little as possible while the system is being calibrated!***

1. Set the distance controller for horizontal scaling (zoom) to the center. Make sure that the tick has been inserted in the box for symmetrical scaling.
2. The first step involves horizontal calibration. Please ask the test person to look at the first calibration point (calibration point 1).

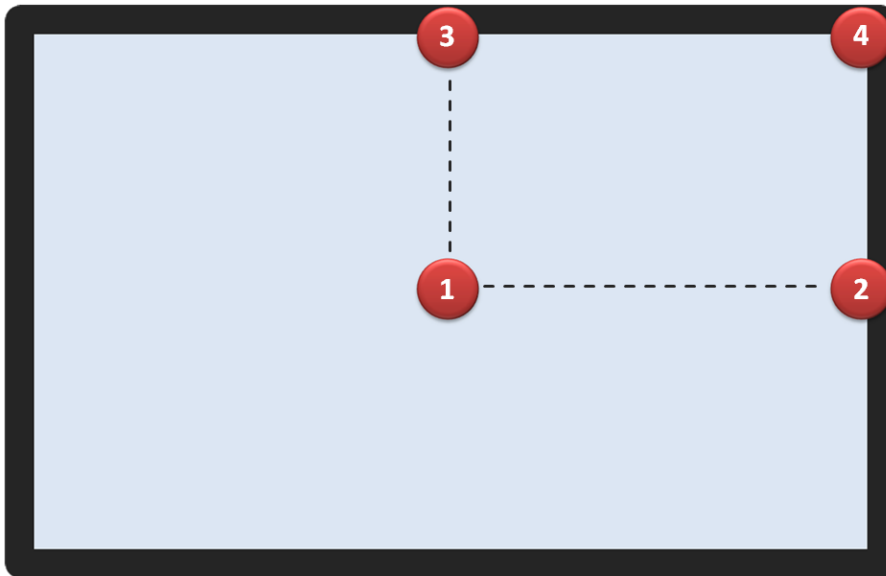


Figure 2-37: examples of calibration points on the computer screen

3. Use the calibration tools mentioned above (left/right, up/down) to align the cross-hair (symbolizing the current viewing direction) and the calibration point.
4. Afterward, ask the test person to look at the second calibration point (calibration point 2) which is to the right of the first calibration point (horizontal calibration). Make sure that the test person does not move his/her head when doing so!

If the cross-hair does not jump far enough, meaning it is located somewhere between calibration points 1 and 2, increase the horizontal scaling factor (move the zoom controller to the right).

Should the cross-hair jump too far, meaning it is located to the right of calibration points 2, reduce the horizontal scaling factor (move the zoom controller to the left).

5. Ask the test person to look at calibration point 1 again. This point will have moved slightly due to the scale adjustment. Use the two position-adjustment controllers (left/right, up/down) to align the cross-hair with calibration point 1.
6. Ask the test person to look at calibration point 2 again and check if the cross-hair jumps far enough with this new distance setting. Repeat steps 4 through 5 until the horizontal calibration for calibration points 1 and 2 is correct.
7. The next step involves the vertical calibration. Please remove the tick for symmetrical scaling (at the top right of the calibration area).
8. Ask the test person to move his/her focus from calibration point 1 to calibration point 3 without moving his/her head.

If the cross-hair does not move far enough with the current vertical distance setting (e.g. the cross-hair simply ends up somewhere near calibration point 3), you will have to move the vertical scrollbar for the distance (stretch) control slightly upward.

Should the cross-hair jump too far, meaning it is located above point 3, reduce the vertical scaling factor. To do so, move the stretch controller downward.

9. Then ask the test person to look at calibration point 1 again and use the vertical scrollbar for position setting to align the cross-hair with calibration point 1.
10. Ask the test person to look at calibration point 3 again and check if the cross-hair jumps far enough with this new distance setting. Repeat steps 8 through 9 until the vertical calibration for calibration points 1 and 3 is correct.
11. Then recheck calibration points 1, 2 and 3 one after another. If necessary, check a fourth calibration point to check the accuracy and readjust the calibration slightly.
12. If the cross-hair jumps to all of the calibration points, the test person is calibrated for the monitor plane and you can track his/her glance behavior in real time. The test person should only refrain from moving his/her head during calibration.

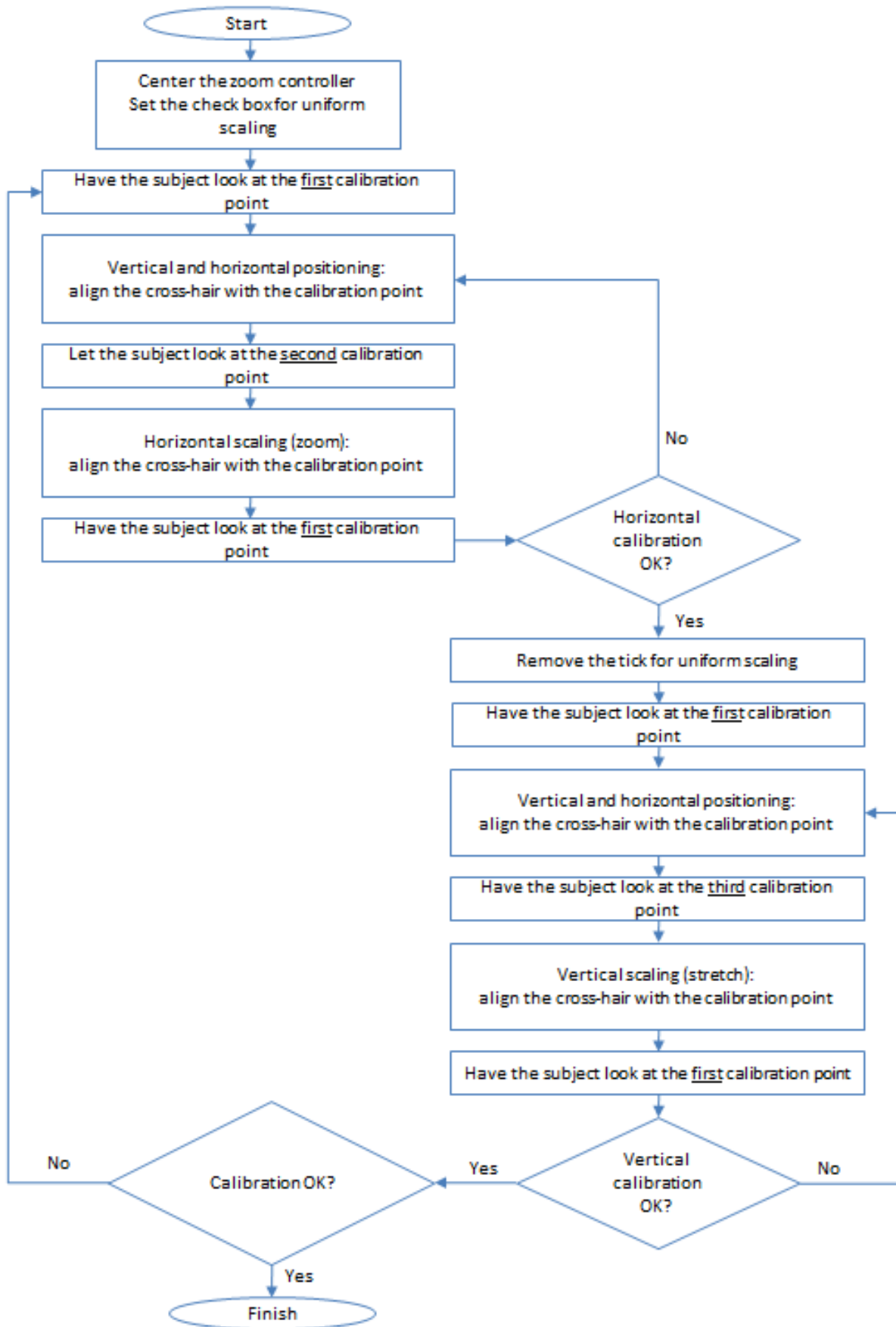


Figure 2-38: flow diagram showing the calibration sequence



### 2.3.15 Recording Eye Tracking Data

Once you have created or opened a project, have created a subject and made all of the necessary system adjustments, you can start recording.

1. Click the "Start Record" button to start recording. The button outline will change color from green to red and the text will change to "Stop Record". The time counter in the preview window shows how long the system has been recording.
2. To stop recording, simply press the "Stop Record" button.
3. You can repeat these steps to add further recordings to your subject.

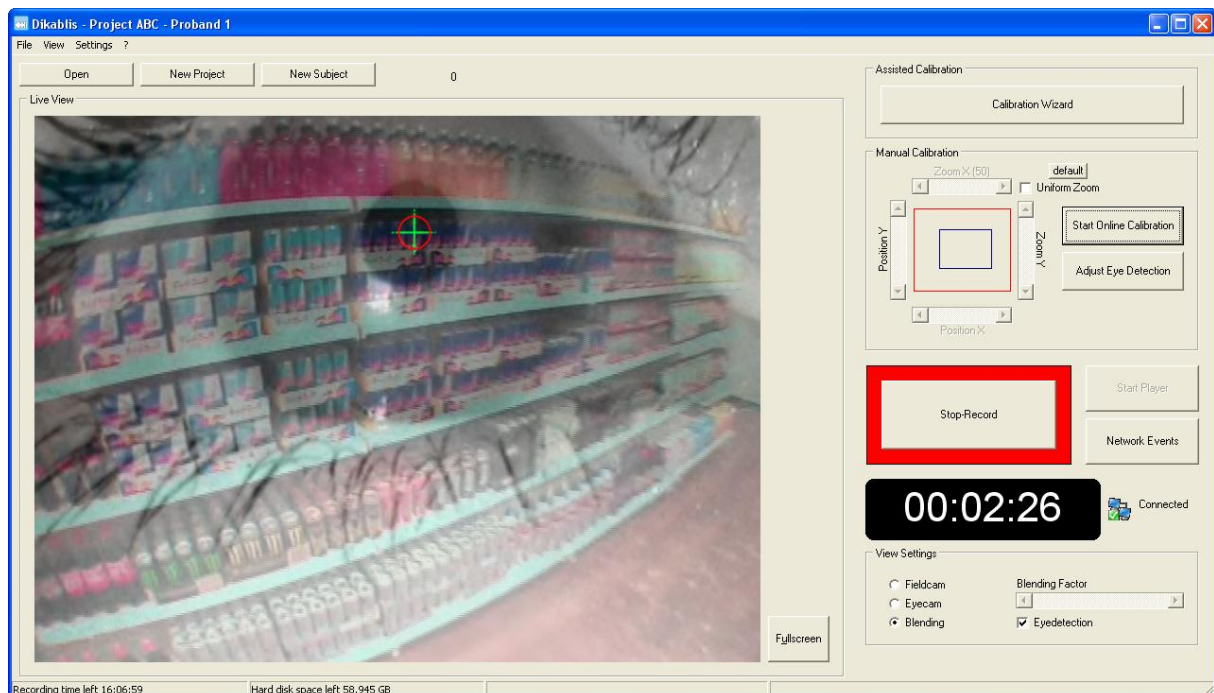


Figure 2-39: active eye tracking data recording

### 2.3.16 Setting Triggers

While recording, you can activate and deactivate triggers via the network interface (for the network protocol, see section 5 Dikablis Network Interface and Expanded Functions) or the keyboard. More than one trigger can be active at one time.

To activate a trigger, press the appropriate key (which you defined in section 2.3.8) on your recording computer keyboard or activate the corresponding network command. If a trigger key has not been defined beforehand, the recording software will ignore the key when pressed.

**Single trigger:** If you wish to analyze a particular situation at a later stage, you can use a single trigger to write a single entry into the journal file. To do so, the pre-defined key must be pressed once. You can later select this trigger in the trigger list located there and jump to the time when this event occurred in the eye tracking video.

**Interval trigger:** An interval trigger can be used if a particular time interval is to be marked directly online during recording. For example, if you want to mark the beginning and end of a task during the test, you can choose an interval trigger which you must press at the beginning AND at the end of the task. This will cause the task interval to be recorded directly online. Using the analysis software, you can choose the respective interval trigger in the trigger list and then jump directly to the beginning or end of the task in the eye tracking video.

### 2.3.17 Displaying (Network) Events

Press the "Network Events" button in the main window of the recorder to open the window from Figure 2-40. All of the events and triggers received for the current subject during data recording are listed here.

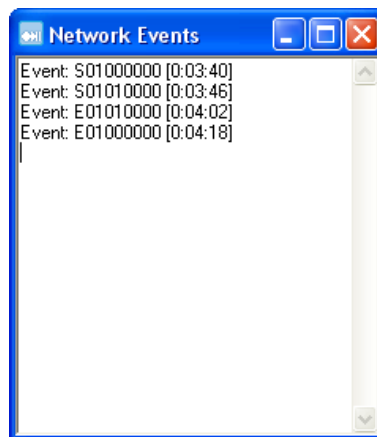


Figure 2-40: received events

To receive network events, the transmitter of these events must be linked to Dikablis via the interface described in section 5 "Dikablis Network Interface and Expanded Functions". The symbol on the right next to the time display shows if there is a connection or not (Figure 2-39 shows a connection and Figure 2-2 shows no connection).

### 2.3.18 Online Calibration

If you wish to change the calibration while the eye tracking video is being recorded, you can switch to "Start Online Calibration" by pressing the corresponding button (see Figure 2-41). This will activate the calibration fields. Recording will not be interrupted. Press the button once again to end online calibration.

Calibration while eye tracking data is being recorded makes sense if the existing calibration becomes inaccurate during the trial, e.g. because the head unit has slipped. Online calibration allows the current calibration to be adjusted or the eye tracking to be completely recalibrated while recording. If, for example, the head unit shifts during the test meaning that the vertical calibration is no longer correct, you can correct the vertical position setting online during recording.

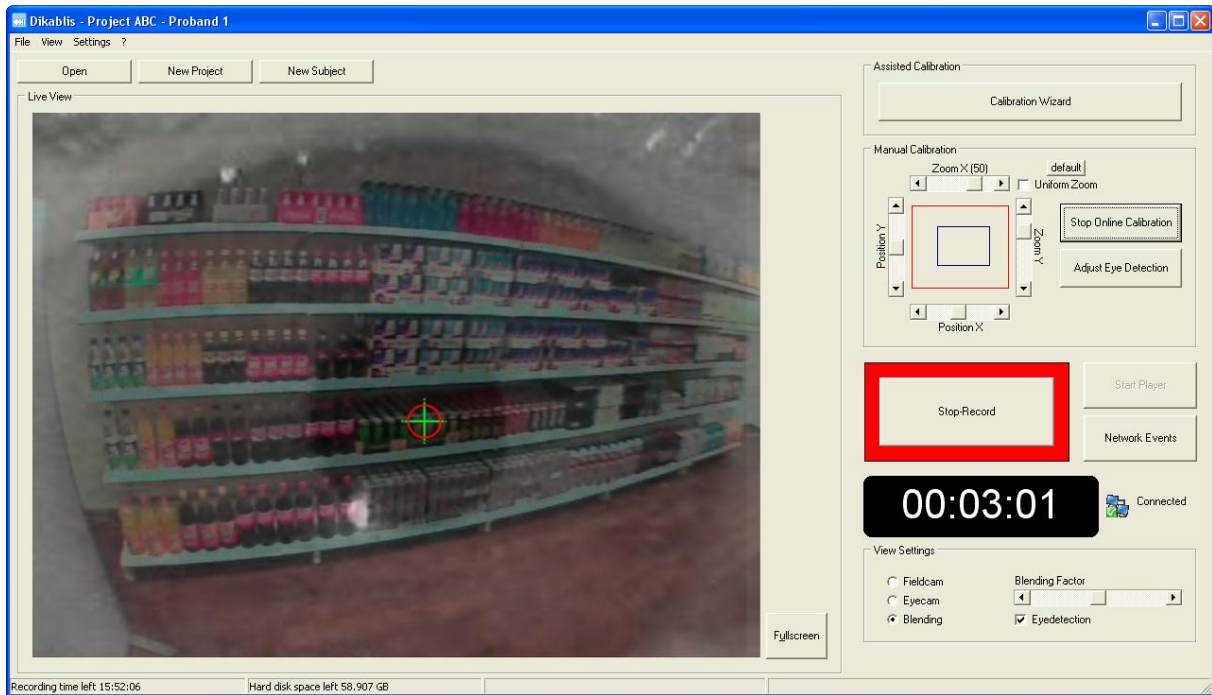


Figure 2-41: online calibration

### 2.3.19 Displaying Recorded Eye Tracking Data

To view the eye tracking video directly after recording, you can start the Dikablis Player directly from the recorder. To do so, press the "Start Player" button in the recording software window or use the "Start Player" entry in the "File" menu. If you start the player from the recording software, the video will be loaded automatically.

For more detailed information on how to operate the player, see section 2.4.

## 2.4 Dikablis Player

The Dikablis Player's most important function is to play back eye tracking videos. The player is a license-free application and can be installed on any computer (for the system requirements, see section 2.1). The player can be used to visualize the glance behavior in the data recorded using the Dikablis recorder.

### 2.4.1 General Outline

The Dikablis Player's user interface is shown and its most important functions marked in Figure 2-42. The main area comprises the window for displaying the eye tracking videos. The recorded eye tracking data (both the original data and the data have already been edited using the analysis software, see section 2.62.6.1) can be played back with the Dikablis Player.

In addition to the normal playback of an eye tracking video, the player can also display the eye tracking video in fast-forward or rewind mode *at a range of playback speeds*. In order to analyze specific glance sequences in detail, there is a *frame-by-frame analysis* option available in which you can progress forwards or backwards through the video, one frame at a time. With the *time bar*, you can quickly jump to a specific point in the video.

If you activate the loop function, the eye tracking video will be played in an *infinite loop*. The reason for this feature is so that the video does not need to be continually restarted in a presentation or at a trade fair for example.

Should you wish to perform a targeted analysis on the eye tracking video, the player offers an opportunity to select the display format. To do so, you have the following *display options*: field camera (for displaying the video from the field camera), eye camera (for displaying the video from the eye camera) and blending (semi-transparent videos are played one on top of the other). Using the "eye detection" option, you can set whether or not the focal point (displayed as a cross-hair) is displayed in the video.

## 2.5 Working with the Dikablis Player

### 2.5.1 Starting the Player

You can start the Dikablis Player in two ways:

1. The player can be started directly from the recording software. You can either press the "Start Player" button or can select the "Start Player" entry in the "File" menu. If you start the player directly from the recording software, the video last recorded for the current subject will be loaded automatically.
2. Of course, you can also start the player separately. Double-click on the "Dikablis Player" symbol on the computer desktop or select the "Player" entry in the Dikablis start menu.

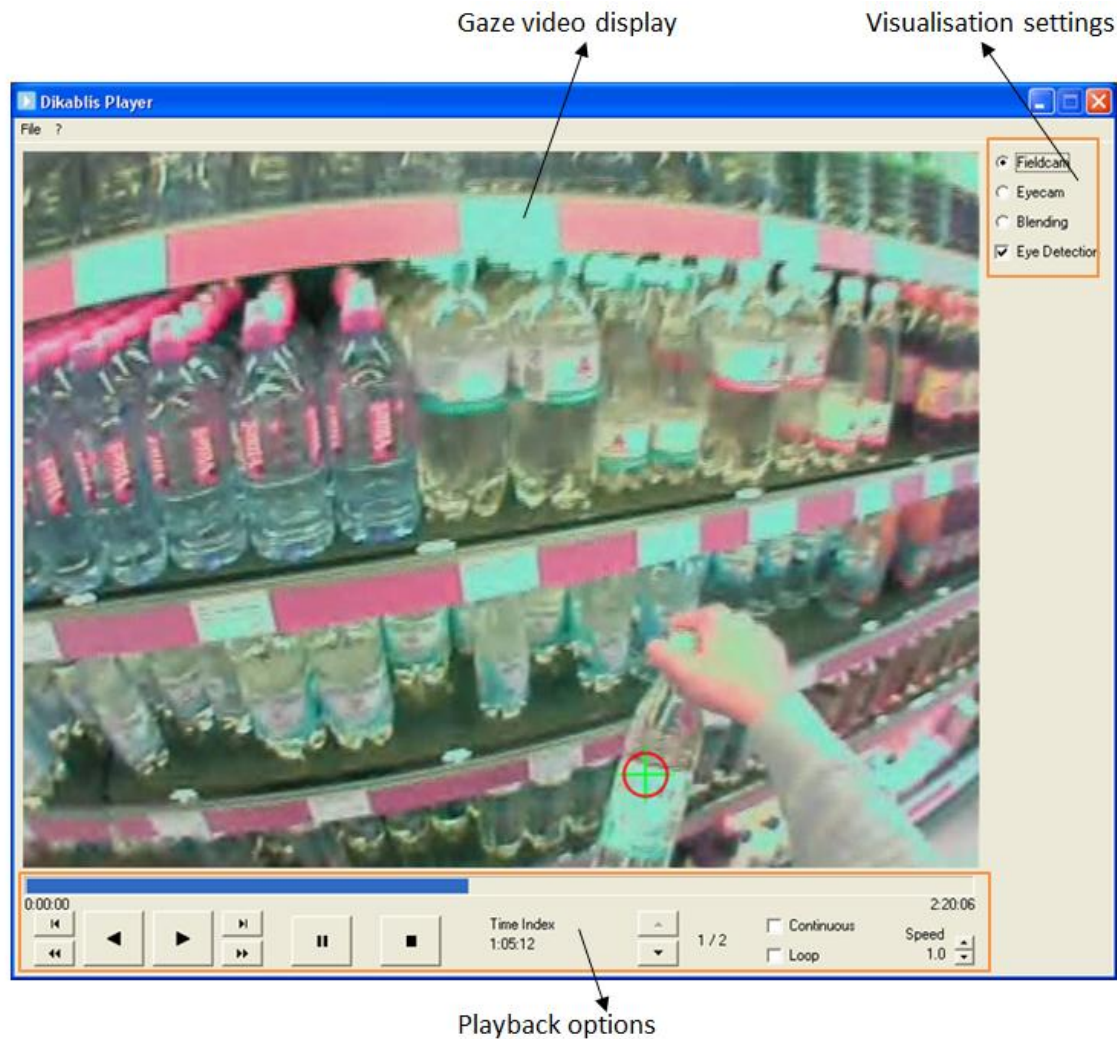


Figure 2-42: general layout of the Dikablis Player

## 2.5.2 Opening an Eye Tracking Video Recorded Locally

To play an eye tracking video, proceed as follows:

To open a subject, perform the following steps one after another:

1. In the "File" menu, select the "Open" entry.
2. The "Open Subject" dialog will be opened (see Figure 2-43).
3. A list of all existing projects (located in the specified standard path, see section 2.3.7 Changing the Location where the Project is Saved) is displayed in the dialog window. Use the "+" symbol to open the required project and select the subject with the data you wish to view in the player.
4. Confirm your selection with "OK".
5. The eye tracking video for the test person selected will now be played.

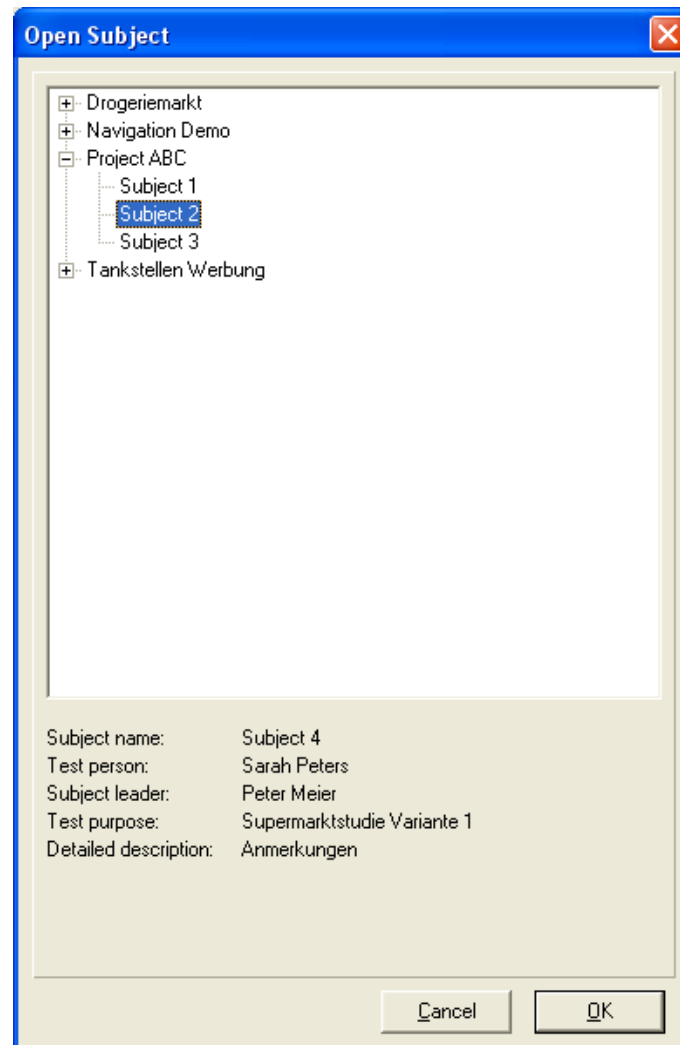


Figure 2-43: selecting the subject to be opened (local)

### 2.5.3 Opening an External Eye Tracking Video

If you want to open an eye tracking video which is not saved on your local hard drive (e.g. on a CD or external drive), you can use the "Open external" option:

1. In the "File" menu, select the "Open external" entry.
2. A navigation window will open. Navigate to the folder which holds your data.
3. Choose the "experiment.xml" file for the subject you would like to open by clicking on it (see Figure 2-44). Please note that only files with this format can be opened!
4. Confirm your selection with "Open".

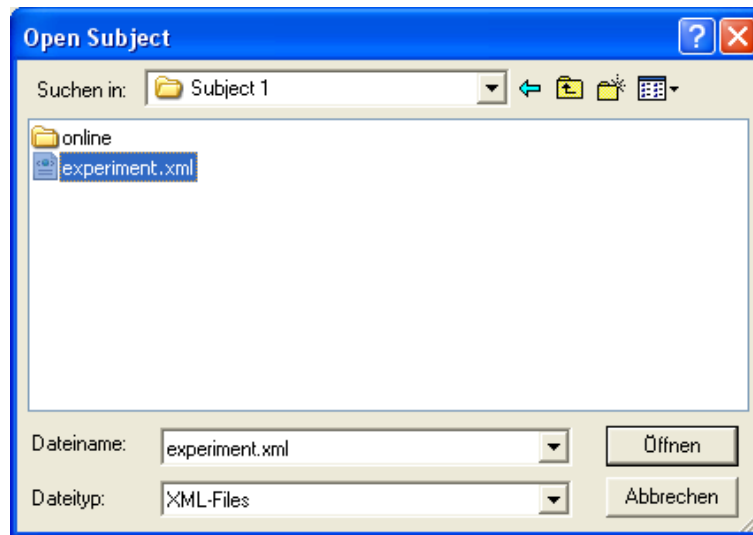


Figure 2-44: selecting the subject to be opened (external)

## 2.5.4 Viewing an Eye Tracking Video

Once you have opened the eye tracking film in the player, the functions labeled in Figure 2-45 are available to help you control the video.

- Play forward/rewind
- Play fast-forward/rewind
- Forward/rewind frame-by-frame for observing individual frames
- Pause and stop
- "Loop" option to play in an infinite loop
- Playback speed: slow speed from 0.1 to 1 and fast speed at twice, five times or ten times the normal speed.
- Time index for fast navigation and for displaying the current position in the film
- Scene selection (only provided if the open subject comprises more than one scene)
- "Continuous" option for the continuous playback of all of the scenes in the current subject (only provided if the open subject comprises more than one scene)

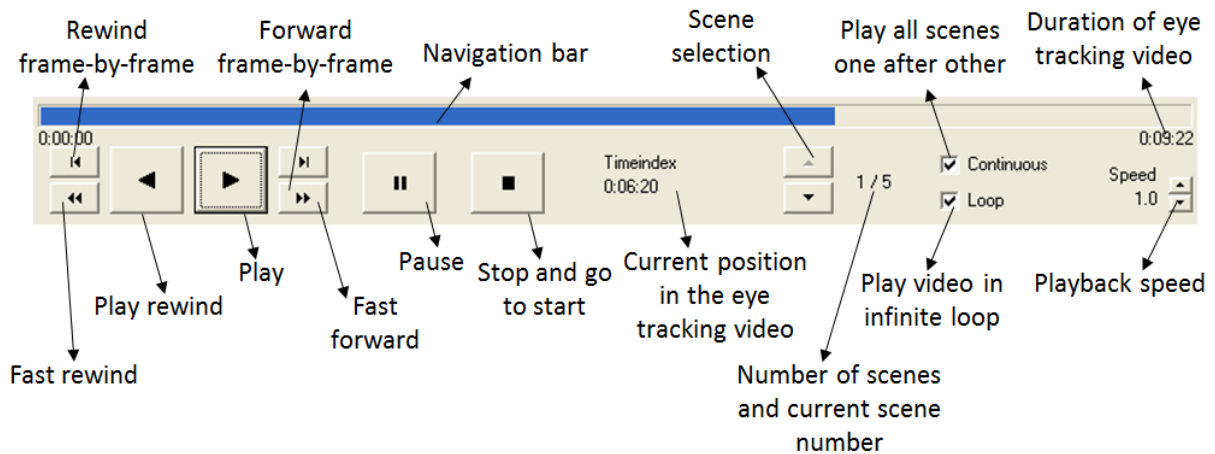


Figure 2-45: Player playback options

## 2.6 Dikablis Analysis

### 2.6.1 General Outline

The analysis software is used for preparing and manually analyzing the obtained eye tracking data. The software is already installed on the recording computer but it can also be installed on any conventional PC or laptop (for installation details, see section 2.1). This allows the analysis and recording software to be used simultaneously on two computers and the amount of time needed for the eye tracking experiments to be considerably reduced.

It is important to note while working with the Dikablis Analysis software that the original data is never edited, but instead local copies are generated when saving. This way, you can always have access to the "raw data" for your eye tracking studies.

The analysis software offers the following modules to edit and analyze eye tracking data:

- **Recalibration:** this module allows the eye tracking data to be calibrated once a test has been completed. If the calibration is no longer correct during a test, you can calibrate the data in retrospect using the analysis software. You can also choose between the different input sources, or change the blending mode (see section 2.3.2).
- **Improving pupil detection:** this function allows you to optimize the pupil detection rate manually or automatically even after the test. This is possible because the video recording of the eye has been saved onto the hard disk. Furthermore, you can prepare high-quality pupil co-ordinates which allow pupil activity to be precisely analyzed.
- **Trigger function:** is used to manually analyze the eye tracking videos and to determine how often the eye's focus was pointed at particular areas of interest (AOIs). The trigger entries are saved in the journal file.
- **Video cut:** using this function, any sections or parts of the recording can be cut out. These sections can be saved on a hard drive and inserted in later presentations.



In the analysis software, to the right of the video playback window, there are four tabs which contain the above-mentioned features. An overview of the analysis software modules and functions is shown in Figure 2-47. The following sections include a detailed and application-related description of the individual analysis software modules.

The different playback options allow you to play the video forwards and in rewind at different speeds, to navigate through the individual scenes of the loaded subject, to display the individual scenes in a continuous sequence and to play the video in an infinite loop. Figure 2-46 shows the playback options area with labeled functions.

If you started and stopped recording data for a subject more than once, you will have recorded several individual videos, or so-called scenes. You can select one of these scenes from the currently opened subject (e.g. 2/5 means scene 2 of 5). Use the scene-selection arrows (see Figure 2-46), to select the required video. The following options are available for playback:

- "Continuous": if you have entered a tick next to this option, the video of the next scene will start automatically once the current one ends.
- "Loop": if you have entered a tick next to "Loop", the current eye tracking video will be repeated after it ends.
- If you have entered a tick next to both options, all of the eye tracking videos will be played one after another. Once the last video has been played, the first one will be started again.

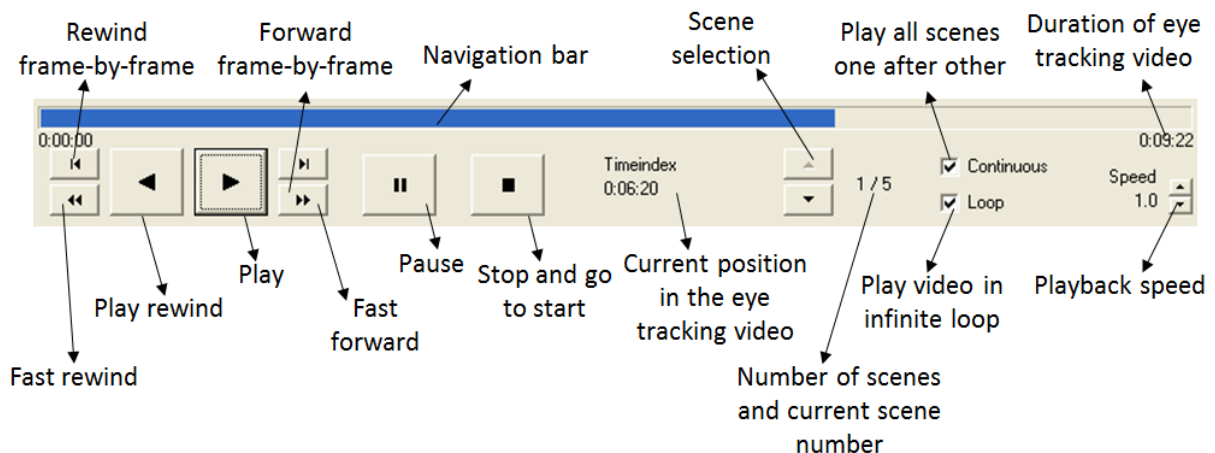


Figure 2-46: analysis software playback options

## 2.7 Working with the Analysis Software

### 2.7.1 Starting the Analysis Software

Before you start the application, connect the USB license stick for the analysis software to the computer on which you wish to execute it.

You can start the analysis software by clicking the "analysis" symbol on your computer desktop or by selecting the corresponding entry in the start menu.

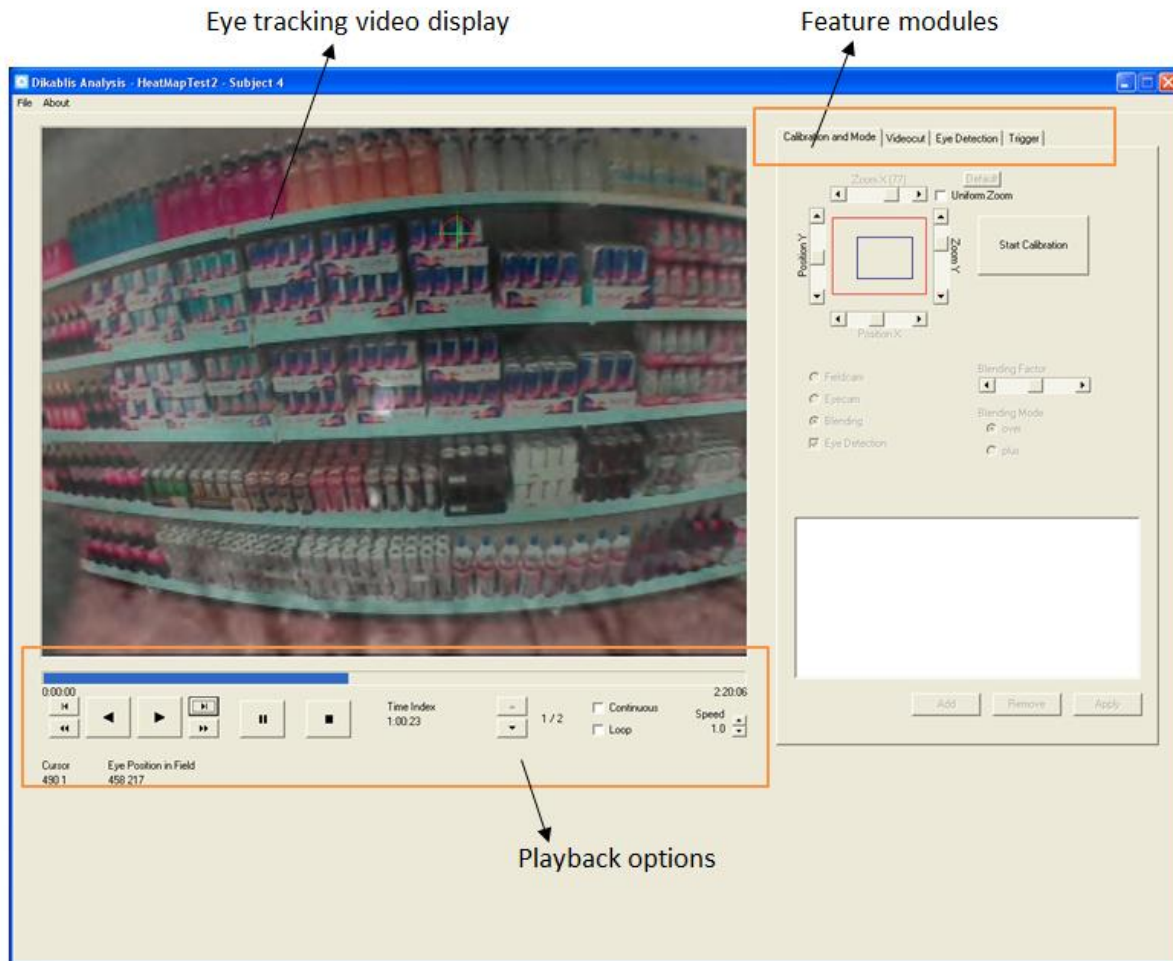


Figure 2-47: general layout of the Dikablis analysis feature

## 2.7.2 Loading Eye Tracking Data (Locally on the Recording Computer)

To load eye tracking data located on the recording computer into the analysis software, proceed as follows:

1. Start the analysis software on the recording computer and select the "Open" entry in the "File" menu.
2. A navigation window, in which all of the projects located in the standard repository path are displayed (see section 2.3.7), is opened (see Figure 2-48). Use the "+" symbol to open the required project and select the subject containing the data you wish to view in the analysis software.
3. Confirm your selection with "OK".
4. The data for the selected subject is now loaded in the analysis software.

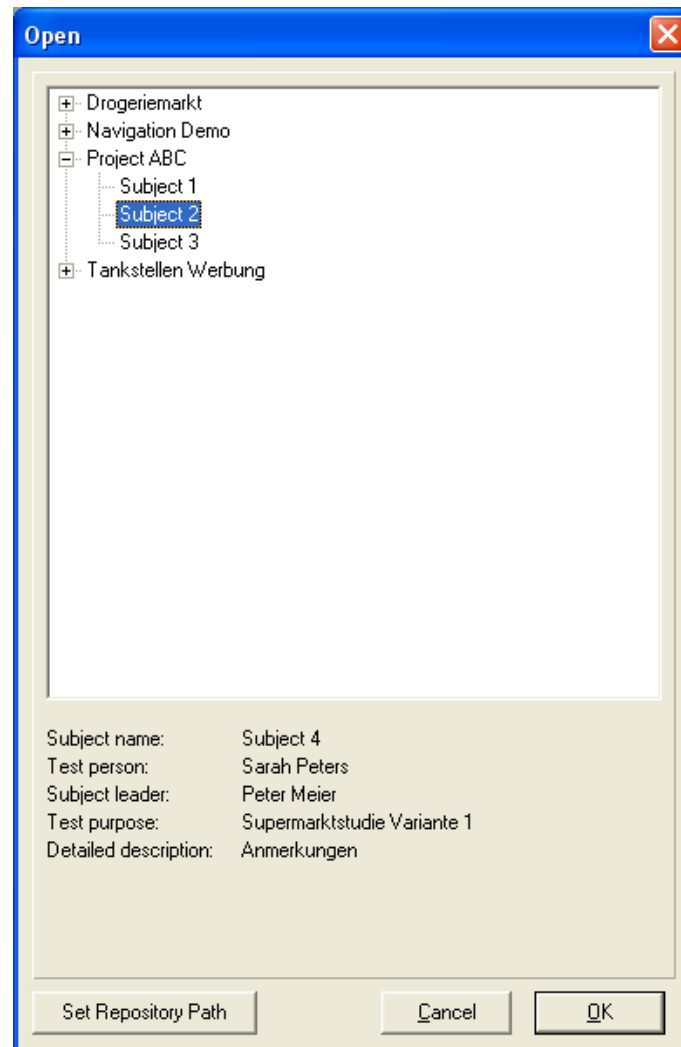


Figure 2-48: selecting the subject to be opened

### 2.7.3 Loading Eye Tracking Data (External)

It goes without saying that you can also analyze eye tracking data which is not located on the recording computer, but rather on a range of non-write-protected media. To load eye tracking data from any location into the analysis software, proceed as follows:

1. In the "File" menu, select the "Open" entry.
2. In the dialog which is opened, select "Set Repository Path" (see Figure 2-48). Note: in the drop-down menu of this window, the last ten repository paths selected by you are saved. This has the advantage that you do not need to enter the path again each time.
3. Enter the new repository path in the opened window, as shown in Figure 2-49. You can also copy the repository path directly from Windows Explorer and paste it in this field. The path you enter must also include the folder in which your project file is located (e.g.: if the project file is in the folder "E:/Backup/Projects 2010" and has the name "Project ABC", then you must enter the following path: "E:/Backup/Projects 2010").
4. Click OK to confirm a new repository path. Then proceed as described in the previous section to load the data from your subject into the analysis software.

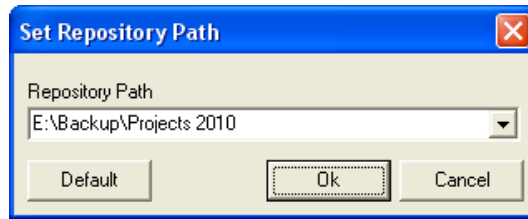


Figure 2-49: entering the new repository path

### 2.7.4 Recalibration

The recalibration function can be found in the "Calibration and mode" tab (see Figure 2-50). Using this feature, you can recalibrate the system if the head unit shifted during the test for example. In addition, if you want to get extremely precise analysis results on a different plane to the one you used for calibrating your system, you can recalibrate to a different distance plane. For example, if you calibrated your system to view objects located at a distance during the test (e.g. traffic signs), you can use the offline calibration feature to adjust the eye tracking system to nearer objects (e.g. the interior). Furthermore, you can change between different calibration configurations. Depending on which direction the test person looks, either one is active.

To recalibrate, use the calibration field in the top area of the tab. You are probably already familiar with this calibration area as the adjustment options are precisely the same as those in the recording software.

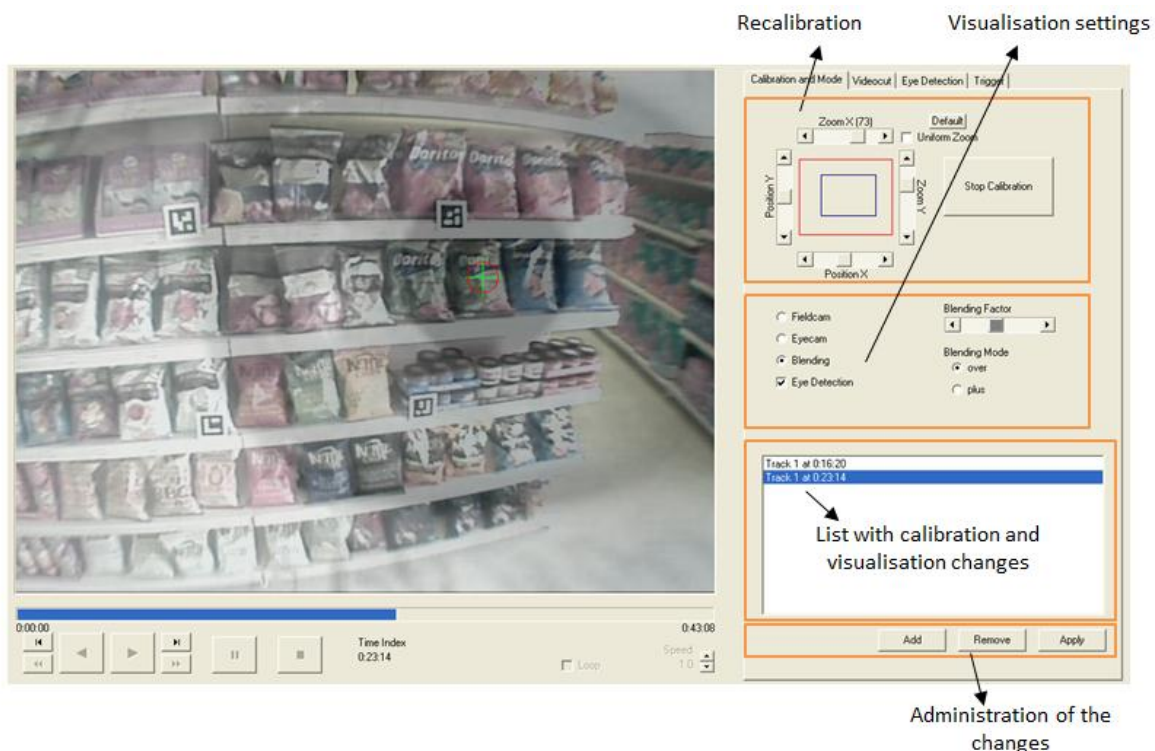


Figure 2-50: recalibration

This is how to recalibrate your system:

1. Go to the point in the eye tracking video at which you want to start recalibrating your system. You can do this using your time bar, for example.
2. The calibration buttons are deactivated and can only be used once the calibration mode has been turned on. Click the "Start calibration" button (see Figure 2-50) to start recalibration. If the eye tracking video was playing when you started calibration, the playback will be automatically paused.
3. Now you can recalibrate your eye tracking video. Follow the instructions given in section 2.3.14. You can still navigate back and forth through your eye tracking video while recalibration is active. To do so, you can use the frame forward and rewind buttons or the video bar below the player window. This allows you to repeatedly adjust the calibration, as described in section 2.3.14 regarding the calibration with the recording software.

You can select the visualization you require with the "field camera", "eye camera" and "blending" buttons (see section 2.7.5 Changing the Display Options). If you enter the tick next to "Eye detection", the cross-hair will appear.

4. If you are pleased with your new calibration configuration, you can activate it by clicking the "Add" button. This will add a new entry to the list underneath the calibration area. The new calibration will now be activated at the time it was defined for and will remain active until the end of the eye tracking video (unless recalibration is performed once again at a later point in the eye tracking video). If you select an entry in the list of calibration points, the video will jump to the position in question.
5. The above steps can be repeated as often as required. This way, you can assign different calibrations to different scenes of the eye tracking video.
6. To change an existing calibration point, select the one you want from the list of calibration points, make the required adjustments and then press "Apply" to apply the changes.
7. If you wish to delete an existing calibration point, select it from the list and press "Remove".
8. Press "Stop calibration" to exit the calibration mode.

The list of calibration points in Figure 2-50 contains two entries. First of all, recalibration was performed at the time 0:06:21 (6s 840ms). The calibration was adjusted again at the time 0:22:12 (22s 680ms). Until the first calibration entry was made, the original calibration set during recording was active. The calibration setting for the first point in time which was entered is active between the first and second calibration. The second calibration point is active from the second entry until the end of the eye tracking video. The adjusted calibration settings are taken into consideration when the eye tracking video is played back - meaning that it is the recalibrated eye tracking video which is displayed in the window.

### 2.7.5 Changing the Display Options

As is the case in the recording software and the player, it is also possible to adjust the display options for the played back eye tracking video in the analysis software. The following options are available: field camera (Fieldcam), eye camera (Eyecam) and blending mode (Blending). You can also configure

the transparency factor when adjusting the latter. A detailed description of these options can be found in section 2.3.2).

The function for adjusting the display options can be found together with the recalibration function in the "Calibration and mode" tab (see Figure 2-51). The display options are located below the calibration field and are only active if the calibration mode is active. Proceed as follows to change the display options.

1. Go to the point in the eye tracking video where you want to change your current display configuration.
2. Click the "Start calibration" button. This will activate the display options.
3. Select the required display mode (field camera, eye camera or blending). For the blending mode, you can enter the level of transparency you require for superimposing the videos using the "blending factor" controller.
4. Confirm the change by pressing the "Add" button. This will add a new entry to the list above this button. The new display options are valid from the time for which they were defined until the end of the eye tracking video (unless other display option changes are made at a later point in the eye tracking video).
5. The above steps can be repeated as often as required. This way, you can assign different display options to different scenes of the eye tracking video.
6. Press "Stop calibration" to exit the change mode.

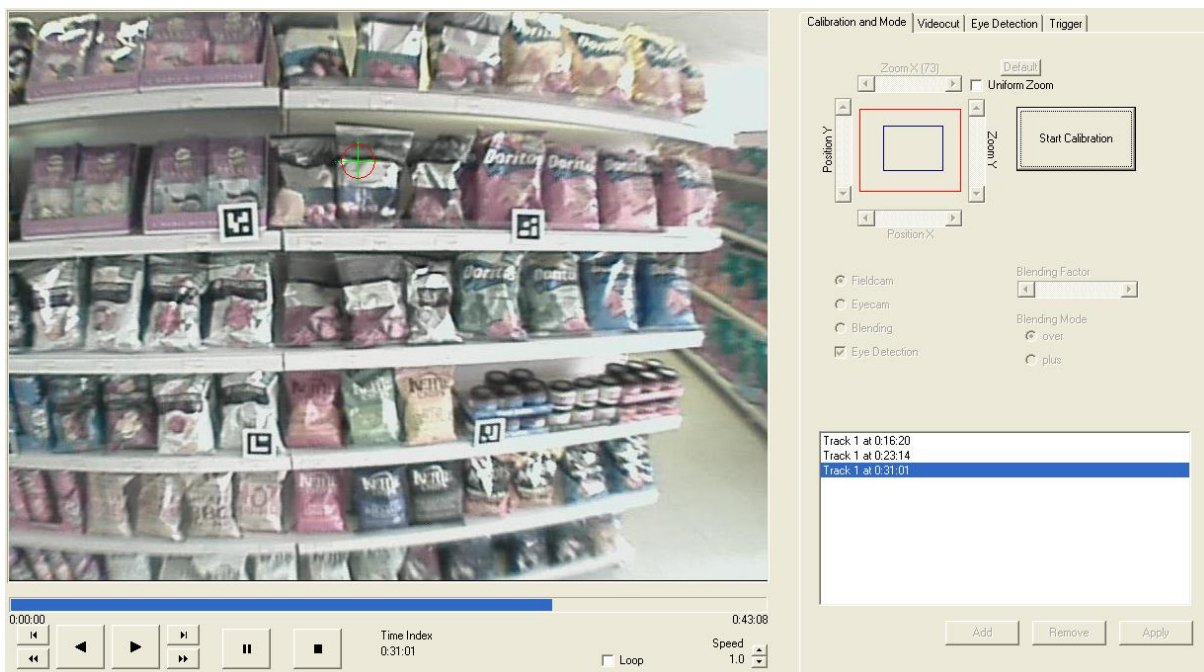


Figure 2-51: changing the display options

The display configuration has been changed from blending to field camera in Figure 2-51. This change was activated at the time 00:31:01 (31s 40ms) and is valid from this time until the end of the eye tracking video.

You can adjust the calibration and the display options in the same step. In such a case, an entry in the list is connected to both the calibration adjustment and the display option changes.

## 2.7.6 Optimizing Pupil Detection

The functions for optimizing the pupil detection can be found in the "Eye Detection" tab. The currently valid pupil detection (recognition) rate is displayed in the top area of the tab (see Figure 2-52). This rate indicates in what percentage of all of the frames the pupil was successfully detected. An optimum value here is somewhere between 94 and 96% as there are always frames in which the test person blinks and consequently no pupil is detected. The detection rate is refreshed after each optimization step meaning that any success can be noticed immediately.

You can select from two pupil detection options: automatic and manual.

Using the *automatic pupil detection*, you can change the settings of the pupil detection algorithm and conduct additional pupil detection with the new settings. This can improve your detection rate drastically (e.g. if the lighting changes during your trial). Using the *manual pupil detection*, you can have the analysis software display each individual frame without a detected pupil and then mark the pupil manually. This way you can refine the pupil detection results immensely (e.g. this is necessary if you want to measure the pupil activity using x and y-coordinates of the pupil center).



Figure 2-52: ways of optimizing pupil detection

### Automatic Pupil Detection

Here, there are two additional options: the automatic pupil detection feature can either be applied to all of the frames in an eye tracking video or to just the one in which the pupil detection algorithm could not detect a pupil. You can set it by entering a tick in the "invalid only" check box in the automatic calibration area, or not. If a tick is entered, the subsequent pupil detection will only be applied to those frames in which a pupil had not yet been detected.

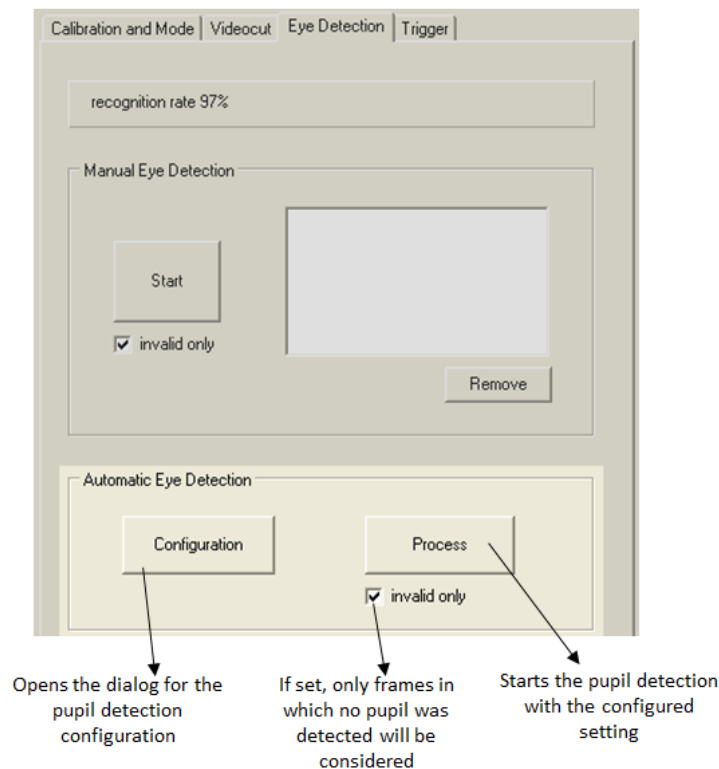
Usually, the pupil detection feature only needs to be automatically optimized for certain time intervals in the eye tracking video. To do so, the pupil detection algorithm needs to be adjusted to suit the lighting conditions for the time interval in question to achieve the best optimization results. Proceed as follows:

1. Go to the relevant time interval in the eye tracking video:

To do so, please use the time bar below the player window or use the playback control buttons to reach the point you want in the eye tracking video.

If you have already used triggers or network events during the test to mark time intervals which are important for the analysis, or in which there were pupil detection problems, you can use them to jump directly to the corresponding moment in the video. To do so, switch to the "trigger" tab. After selecting the trigger (and thus jumping to the corresponding moment in the eye tracking video), switch back to the "Eye Detection" tab.

2. Reduce the playback speed to 10% of the normal speed so that the playback is very slow (see Figure 2-46).
3. Now click "Configuration" in the "Eye Detection" tab (see Figure 2-53) to configure the pupil detection feature.



**Figure 2-53: automatic pupil detection**

4. The "Eye Detection Adjust" window now opens (see Figure 2-54). The video playback will start slowly (at 10% of the normal speed) from the point in time you selected when opening this window.



5. Now adjust the pupil detection to match the lighting conditions of the environment in the relevant time interval. The slow speed helps you to easily adjust the pupil detection feature. (See section 2.3.13 Pupil Detection Configuration for information on how to adjust the pupil detection feature). You can monitor the effect your changed settings have on the pupil detection algorithm in the "Eye Detection Adjust" window.
6. Once you are happy with your settings, confirm them with "OK".
7. Before starting automatic pupil detection, it is important that you activate the "Invalid only" option, as shown in Figure 2-53. This ensures that the global pupil detection is only improved and never impaired. Only pictures in which no pupil was detected are examined.

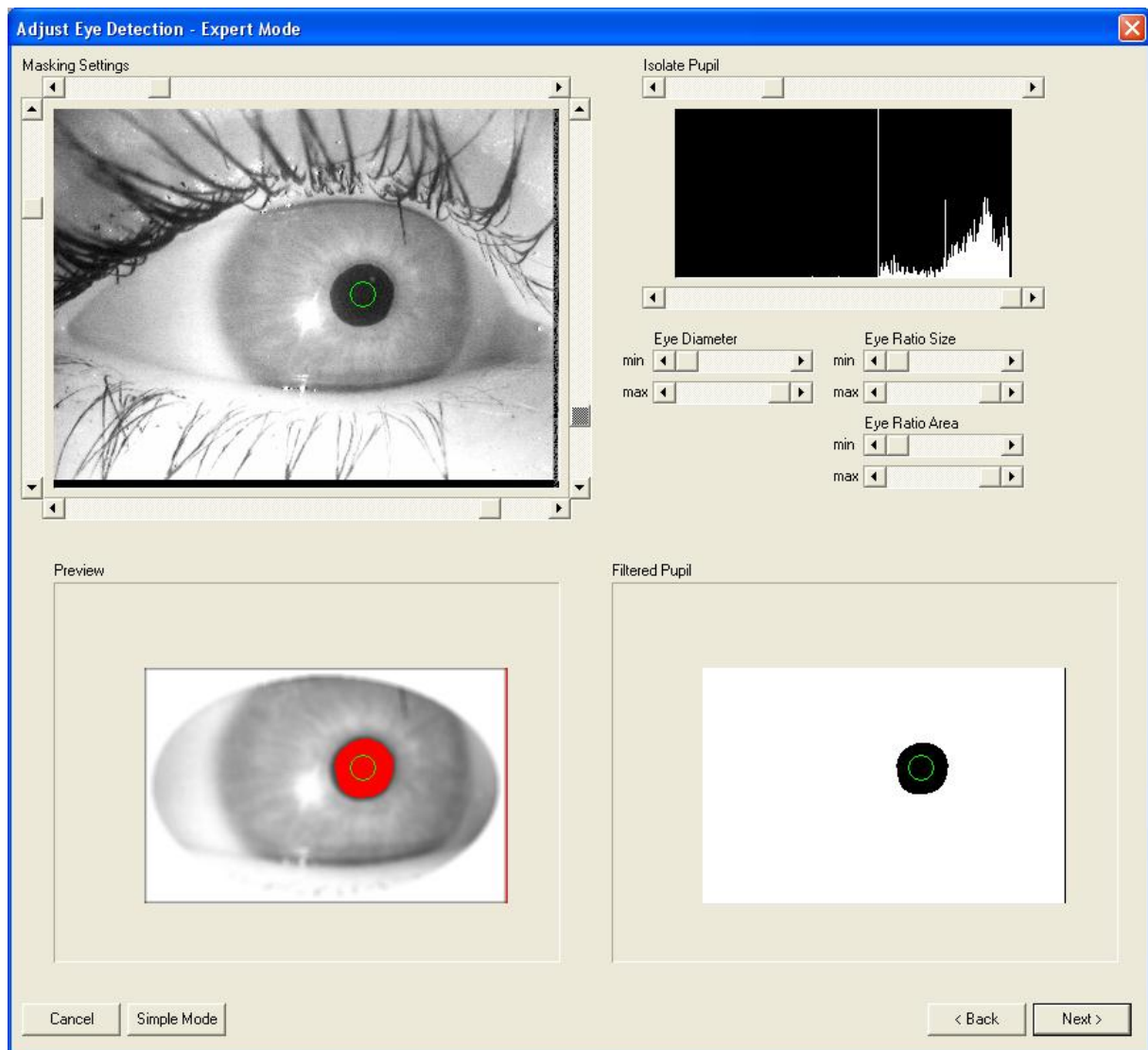


Figure 2-54: configuring the automatic pupil detection

8. Now click the "Process" button to start automatic pupil detection. The Dikablis analysis software now only analyses images from the eye tracking video in which the pupil had yet to be detected. Images in which the pupil had already been detected are not analyzed.
9. Once the process is finished, check if the pupil detection rate has improved in the relevant time interval. You can find information about the effect on the detection rate in the entire eye tracking video by viewing the percentage value in the top area of the tab.

Should the lighting conditions change dramatically in the relevant time interval, go to the respective moment in time and repeat the adjustment of the pupil detection and the automatic improvement process to suit these changed conditions.

You can also repeat this procedure as often as you need to for any other relevant time interval. This way you can improve the pupil detection quickly and easily after the test. This is particularly important for time intervals you may wish to analyze later on.

You can also have the pupil detection algorithm run with the changed settings throughout the whole subject. To do so, simply remove the tick from the "Invalid only" check box.

If there are still frames in which the pupil was not detected, you can manually complete the detection process.

### Manual Pupil Detection

Two additional options are available here. You can perform a complete pupil detection sequence manually or you can complete an automatic pupil detection sequence which has already been performed. If you have inserted a tick in the "Invalid only" check box, the manual pupil detection will only jump to frames in which the automatic pupil detection was unable to find a pupil. This way you can manually detect the pupil. If you do not enter a tick here, every frame will be presented to you. For manual pupil detection, please proceed as follows:

1. Click the "Start" button in the "Manual Eye Detection" area (see Figure 2-52) to start manual pupil detection.

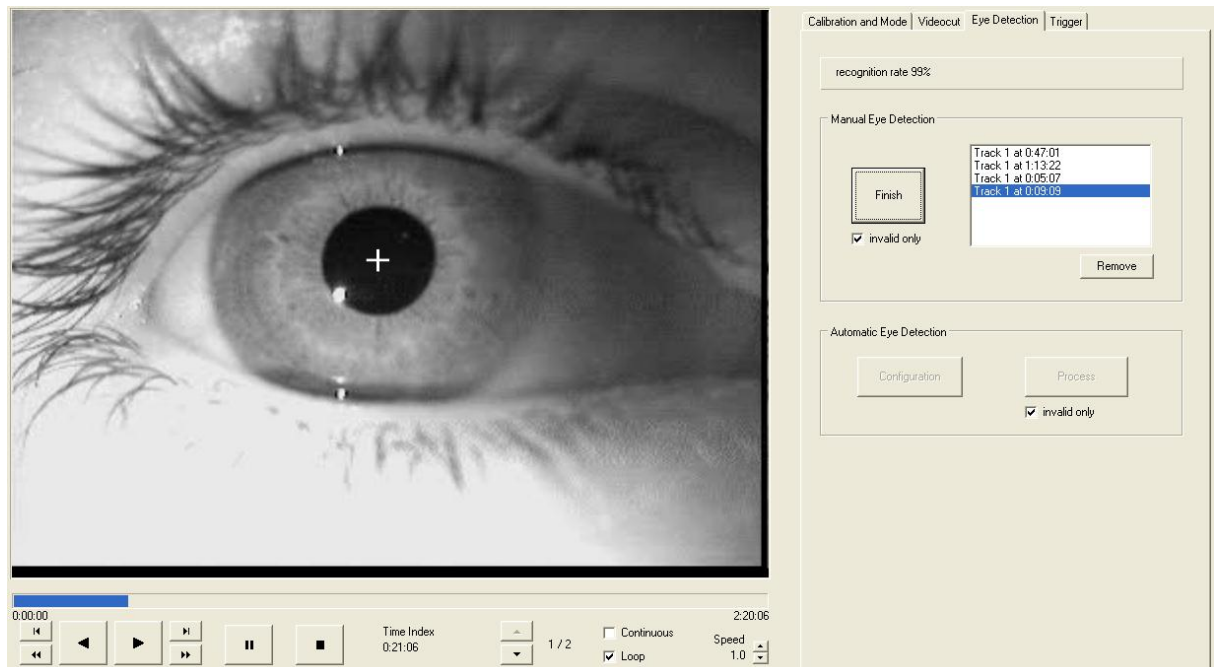


Figure 2-55: manual pupil detection procedure

2. The picture of the eye will be displayed in the eye tracking video from the point in time when you pressed the "Start" button. This means that you can improve the pupil detection manually from the beginning of the eye tracking video or you can start optimizing it from any time in the video.

3. If you move the cursor over the image, you will notice that it changes to a cross-hair (see Figure 2-55). Now move the cross-hair to the center of the pupil and click the left mouse button to mark the pupil position. If you manually mark the pupil, the software will create an entry in the list on the right.
4. The display will now jump to the next image in which no pupil was found.
5. If the pupil is not visible (e.g. if the eye is closed) you can proceed to the next frame by clicking the right mouse key.
6. Repeat steps 3 to 5 until you reach the end of the section for which you want to manually optimize the pupil.
7. If you are not pleased with your manual pupil detection work, you can delete the entry in the list on the right by marking the entry and clicking "Remove".
8. Press "Finish" to exit the manual pupil optimization mode.

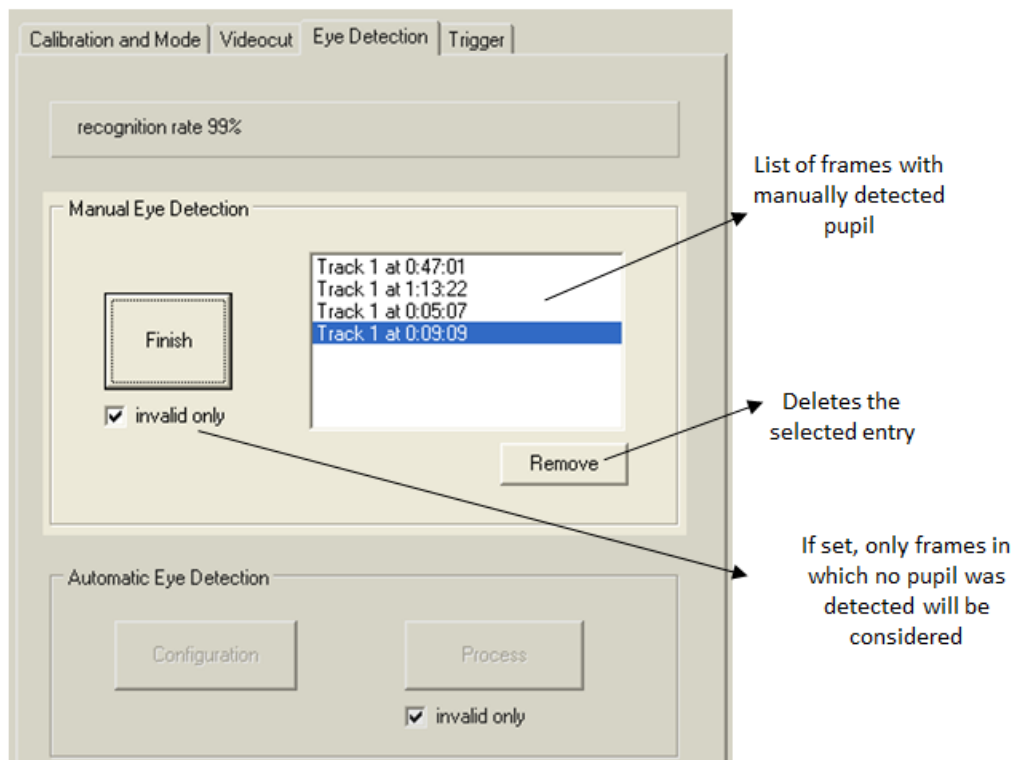


Figure 2-56: manual pupil detection

### 2.7.7 Saving Changes

Dikablis prevents the original online data which was recorded by the recording software from being edited. Consequently, the original data cannot be overwritten. The edited data is always saved separately in its own offline subject folder (see section 2.2.2 Project Structure and Saved Data). If you open a subject for the first time, you will have to save any changes you made as an offline subject as Dikablis does not permit you to edit the raw data.

To do so, follow these steps:

1. In the "File" menu, select "Save As".
2. In the window that opens (see Figure 2-57), enter the name you wish to give the edited subject. Please make sure to give the file a name which means something to you so that it is easy to find again. This name will appear in the corresponding offline subject as part of the offline folder name.

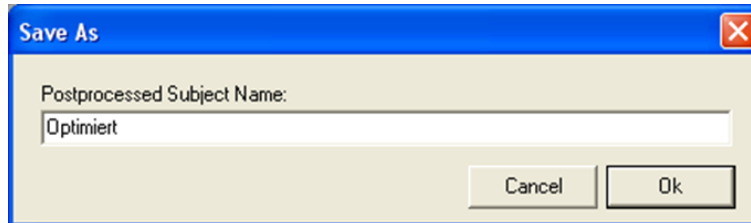


Figure 2-57: saving changes

To load an edited subject in the analysis software at a later point in time, proceed as described in sections 2.7.2 "Loading Eye Tracking Data (Locally on the Recording Computer)" and 2.7.3 "Loading Eye Tracking Data (External)", and select the offline subject you require, as shown in Figure 2-58.

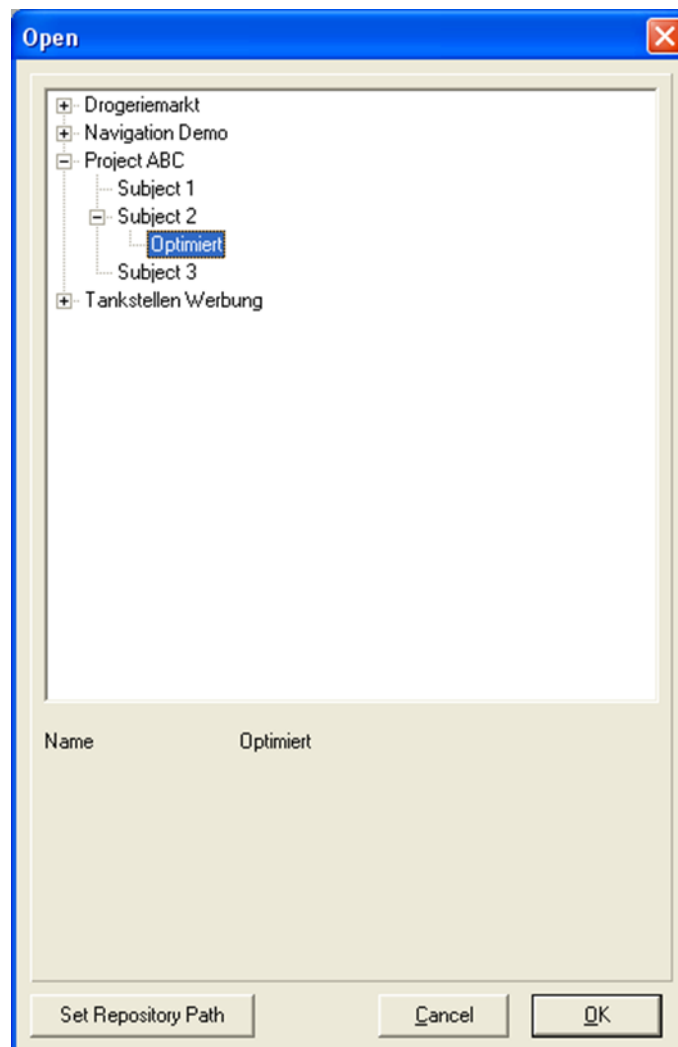


Figure 2-58: loading edited data (offline data)

## 2.7.8 Manual Analysis with Triggers

The functions for defining and controlling triggers can be found in the "Trigger" tab. The trigger module provides the following functions:

- Defining triggers for analyzing the eye tracking experiment.
- The triggers defined using the recording software and set during recording (both the definition and the points in time at which each of the triggers was set) are displayed in the two trigger lists (see Figure 2-59). The top list shows the defined triggers and the bottom list the set triggers.
- The triggers set during recording can be changed and new ones can be added.

### *Defining Triggers*

---

As is the case in the recording software, it is also possible to choose between two types of triggers in the analysis software: single and interval triggers. The single trigger is used to document the frequency that particular events occurred. If it is activated, it produces a single entry in the journal file at the time of activation. The interval trigger is used to measure the amount of time between two same events. If it is activated, the software continues to produce entries in the journal file from the current time until the time it is deactivated.

The function for defining new triggers is located in the top area of Figure 2-59. Its operation is the same as for the recording software (see 2.3.8 "Defining the Defining the Triggers (for Manual Analysis)").

### *Setting Triggers in the Eye Tracking Video*

---

Setting triggers allows you to mark both discrete points in time (single trigger) and time intervals (interval trigger) in the eye tracking video. Intervals can either be the time taken for the execution of a task or the time of a glance at areas of interest.

Consequently, triggers are either set to mark time intervals (e.g. to perform a task) or to manually analyze the time and frequency of glances at certain areas of interest (AOIs).

If you wish to use triggers to manually analyze when and how often a test person is looking at a certain AOI, a trigger needs to be defined for the AOI in question. When carrying out a test in a car, an AOI could be the speedometer (tachometer) which could be represented by the trigger "T" (and the interval trigger "T" would need to be defined for this). In order to analyze how long the test person looked at the "speedometer" AOI, you have to view the eye tracking video with a playback speed of about 30% of the original speed (this ensures a highly accurate manual analysis). Each time the test person looks at the speedometer AOI, you press the key "T" on your keyboard. The "T" key is pressed once again if the test person switches his/her focus from the speedometer to something different. Pressing the "T" for the first time starts the analysis software writing "1" into the journal file (in the column corresponding to the trigger "T"). The system continues writing of all other eye tracking data in addition to this. If "T" is pressed again, the analysis software stops writing "1s" in the corresponding column of the journal file and continues writing "0s". This way, you can analyze for how long and how frequently the eye focuses on up to 36 ("0-9" and "A-Z") different AOIs.

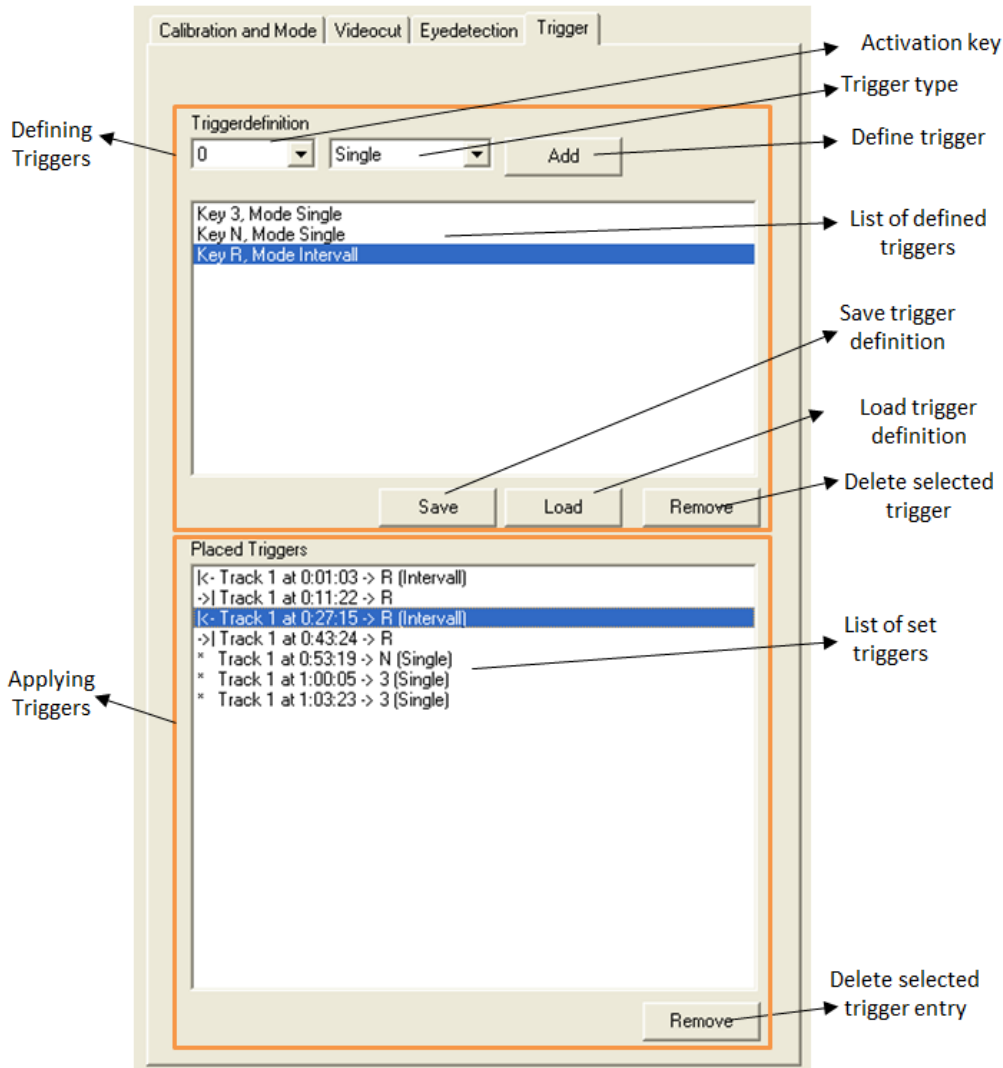


Figure 2-59: defining and setting triggers

If you save a subject after defining and setting triggers, the journal file will be extended to include the new information. Thus, each newly defined trigger enlarges the “Journal File” by one column. The column labeling will be the name of the trigger (in our example the column identifier will be “T”). All of the information about when a trigger was active/ inactive is written into precisely this column. If the trigger was active, a "1" is written, if not, there will be a "0".

Using spreadsheet software (e.g. MS Excel) and the journal file, you can use this information to calculate the time and the frequency of glances at a certain AOIs which were represented by the respective trigger. It is also possible to analyze the glance behavior of a test person with regard to glance sequences and patterns.

The alternative solution to this manual analysis of data is the Dikablis D-Lab software for behavior objectification which automatically analyzes the durations of glances at a certain AOIs. Furthermore, this software contains features to calculate significant characteristic values and is able to display diagrams for visualizing the results.

## 2.7.9 Creating a Video Film

The tab "Videocut" contains features which can cut and export video sequences. You can extract various sequences and join them together to create a video film. The resulting film can then be played on any media player and is MS PowerPoint compatible.

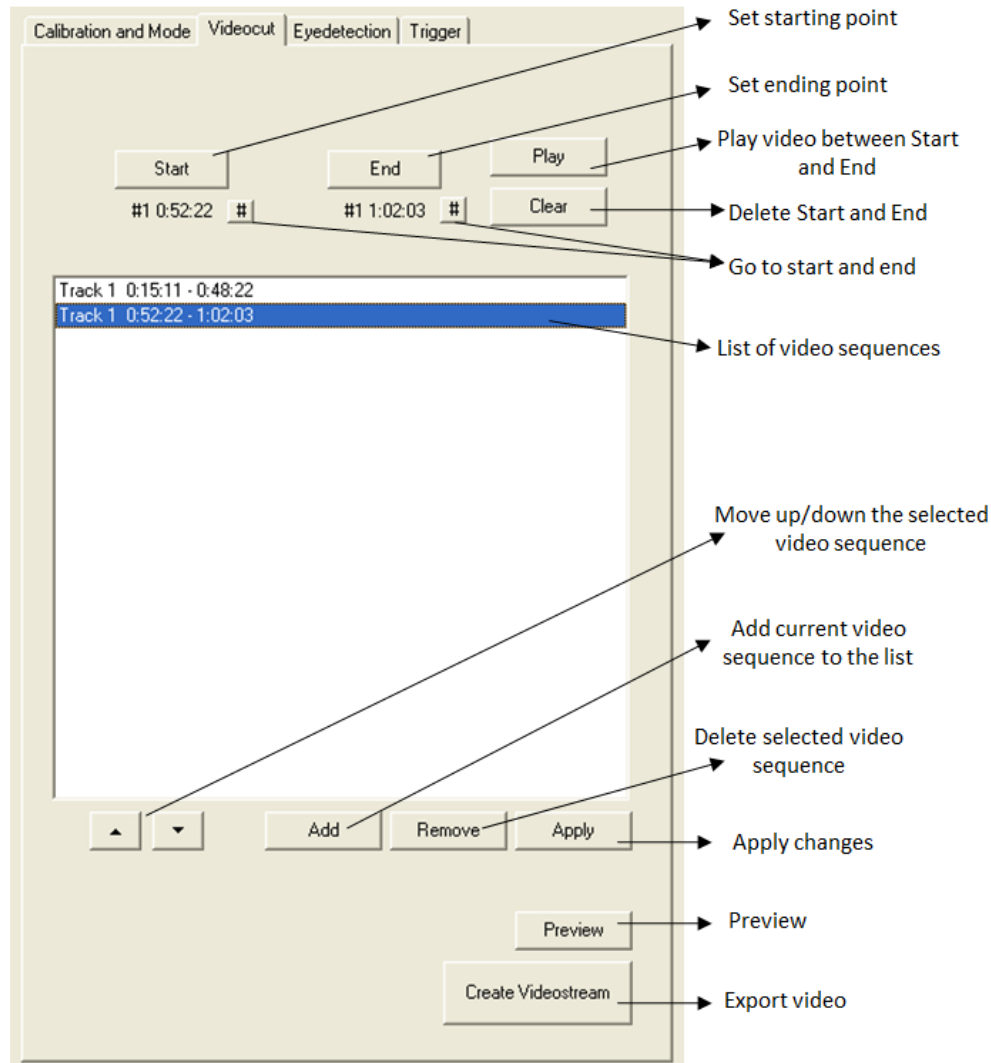


Figure 2-60: video cut functions

To create a video, select the "Videocut" tab and follow these steps:

1. Use the time bar or the playback controls to navigate to the point in time when you wish to start your video. Then press "Start". The current point in the video will be used as the start of the video sequence.
2. Go to the point in time when you want your video to end. Click "End" The current point in the video will be used as the end of the video sequence.
3. Press "Add" to add the marked sequence to the list of video sequences (see Figure 2-60). You can delete the start and end of the current sequence with "Clear".

4. To look at a preview of the current sequence, press "Play". This will open a player window which will play a preview of the cut video sequence.
5. You can add as many video sequences as you like to the list using this procedure.
6. If you are not happy with the video, you can mark the individual sequences and delete them from the list by pressing the "Remove" button.
7. If you want to change the order of your video sequences you can use the "Up" and "Down" buttons. Select a sequence from the list and use the corresponding arrow keys to move it to the desired position.
8. Clicking the "Preview" button will allow you to look at a preview of your movie at any time. The single sequences are joined to form one continuous movie.
9. You can change an existing video sequence by pressing the "Apply" button. To do so, select the sequence, adjust the start and end points and then press "Apply" to accept the changes.
10. Once you are happy with the film, you can export it using "Create videostream" The video film is saved in the folder for the current subject. The video is exported exactly as you saw it in the preview.

Note: it is very easy to export the same video sequences in different perspectives. Leave the videocut list as it is and switch to "Calibration and Mode" to change the settings which determine how the video is displayed in the preview window (e.g. from blending to field camera, see section 2.7.5 Changing the Display Options). If you then export the video once again, it will be exported with the new view setting. [Be careful: if you have not renamed the video which was first exported, it will be overwritten when it is exported].



## 3 FAQ

### **I cannot start the software**

Check that you have plugged in the correct license stick. If the recording software cannot be started, one reason may be that the grabber was not initialized properly or is not detected by the system. This could be caused by a loose contact or maybe the grabber was removed from its slot unintentionally while the recorder was running. Check if the grabber is connected to the recording computer properly and restart the computer. Wait for one to two minutes before you start the recording software. Grabbers need this amount of time for initialization.

### ***I cannot run the Dikablis applications under my user account***

To be able to run one of the Dikablis applications with a user account which is different to the one it was installed under, a number of user-defined configurations must be made. Proceed as follows:

On the supplied Dikablis installation CD, in the "ffdshow" folder, you will find the "ffdshow.reg" file. Log on to the computer using the user name for which the application is to be configured and then execute the file with a double click. The Dikablis software packages can now be run under the configured user account

### ***The recording computer is very slow, the recording jerks a lot***

Make sure that no other programs are installed on the recording computer. The laptop is configured for real-time eye tracking and the internal data flow is optimized for this purpose. Should you install additional software on your laptop, we can no longer guarantee that your system will function properly. Uninstall the additional software which was not installed by Ergoneers GmbH prior to delivery. Check how much free capacity is available on the computer's hard drive.

### ***Nothing is being displayed in the LiveView preview window of the recording software***

Check the system's cables for loose connections. Check the power supply to the cable box, the transmitter and receiver. If you have a Dikablis Wireless system, make sure that both the transmitter and receiver have been set to the same frequency channel.

If the user interface for the recording software is as shown in Figure 3-1, the computer's audio configuration has been incorrectly adjusted. To retrieve the original configuration, proceed as follows:

Use the right mouse key to click on the audio symbol in the Windows status bar. In the menu which appears, select the entry "Set audio properties". An audio configuration window is opened. Select the "Audio" tab. The "IDT Audio" option must be selected both for sound playback and sound recording (see Figure 3-2). Switch over to the "Voice" tab. The "IDT audio" entry must be selected for the voice playback and voice recording. If this is not the case, please change the entry. Confirm your changes with "OK".

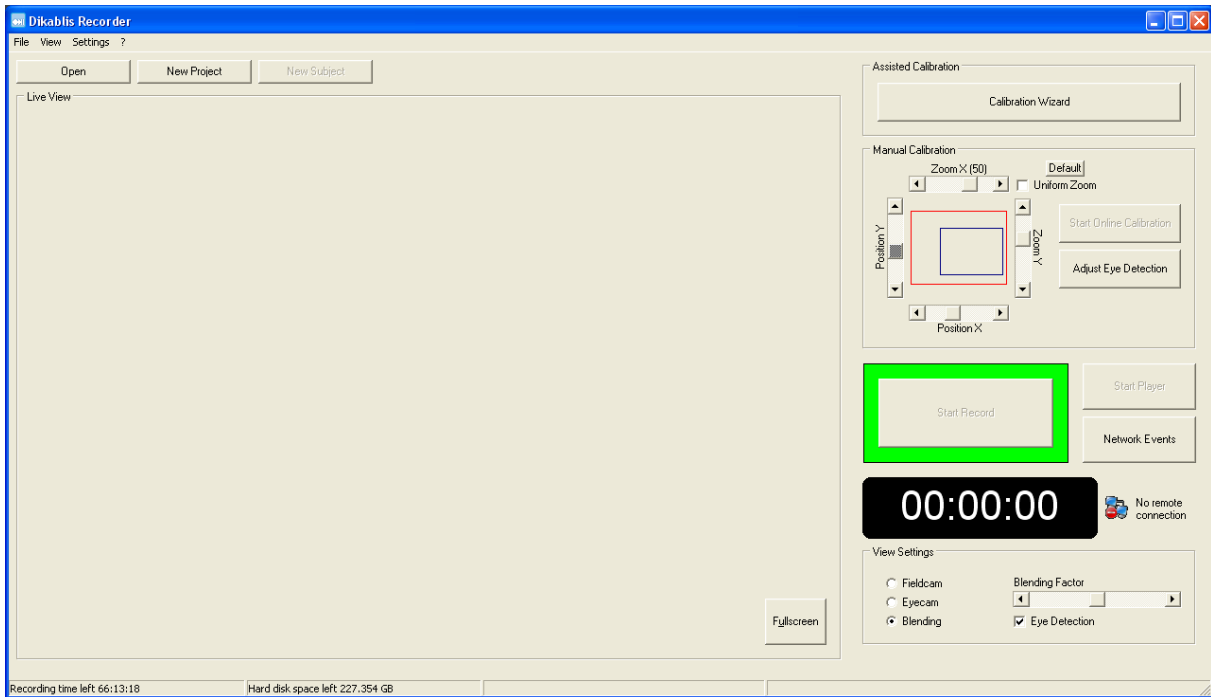


Figure 3-1: impact when the audio configuration is not correct

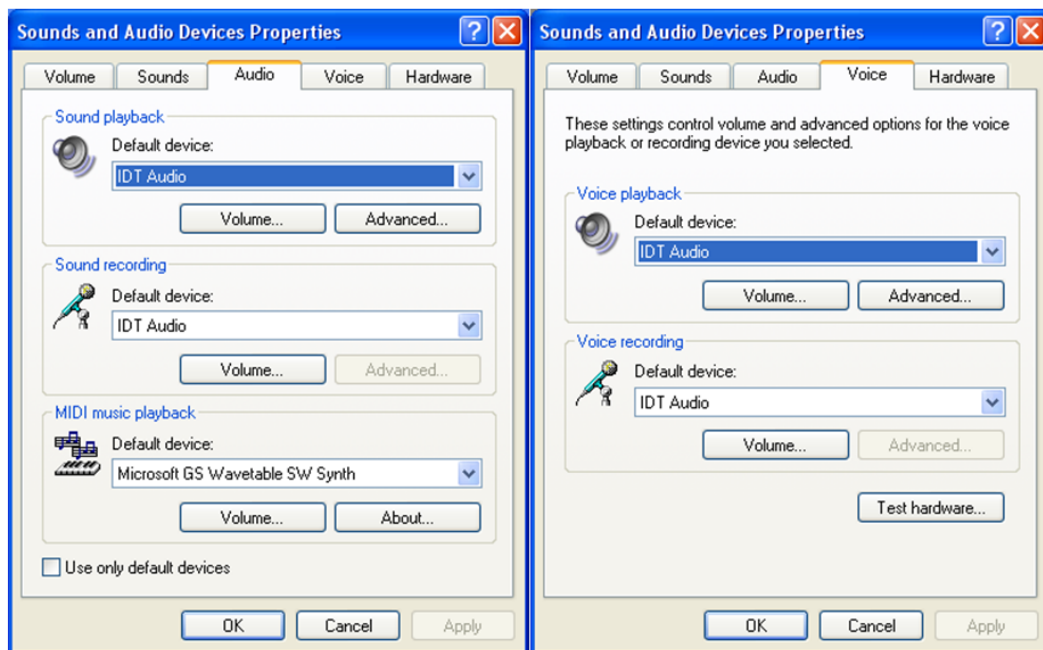


Figure 3-2: audio properties

Now configure the audio settings as subsequently described. Then restart the recording software.

- Double click on the audio symbol in the menu bar on the bottom right of the screen (see Figure 3-3).



Figure 3-3: audio symbol

- The loudness control window will be opened, as shown in Figure 3-4. In the "Options" menu, activate the "Extended settings" item and then select "Properties".

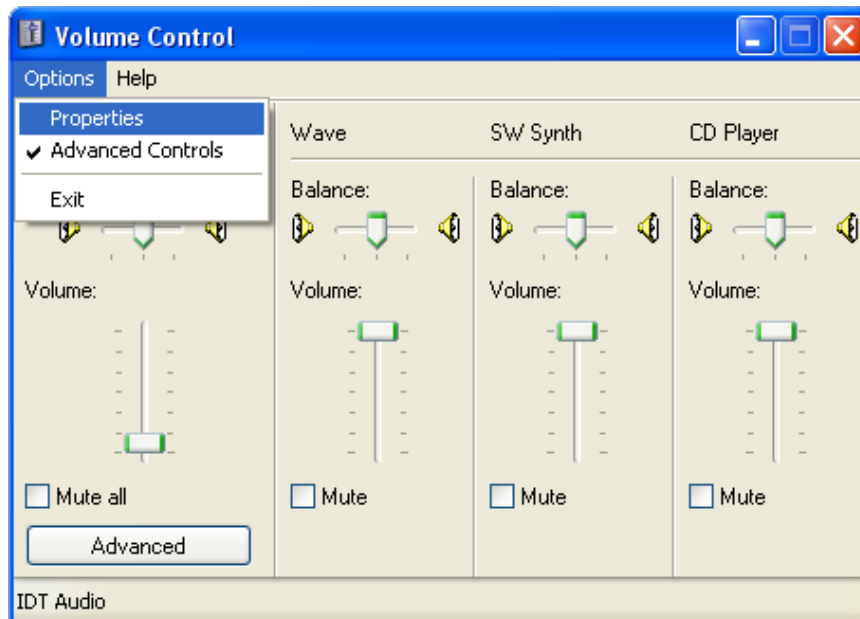


Figure 3-4: loudness control

- In the "Properties" window which has now been opened, select the "Recording" entry in the "Control loudness for" area. Make sure that the "Microphone connection" has been selected in the loudness controller list and confirm the dialog with "OK" (see Figure 3-5).
- The "Recording" window will now open. Select "Microphone connection" here, as shown in Figure 3-6 and position the loudness controller at a medium level. Then press the "Expand" button.
- A window for configuring the expanded settings for the microphone connection will now open. If the "microphone amplifier" check box has not been activated, please do so to achieve optimal sound quality. Then close all of the audio windows.

For test purposes, you can also use the microphone integrated in the laptop for voice recording. To do so, select "Digital microphone" in Figure 3-6 and make sure that the microphone amplifier is active in the expanded settings.

The audio recorder integrated in the computer's operating system is suitable for generally checking the voice recording settings. It allows a voice recording to be made separately from the Dikablis recorder.

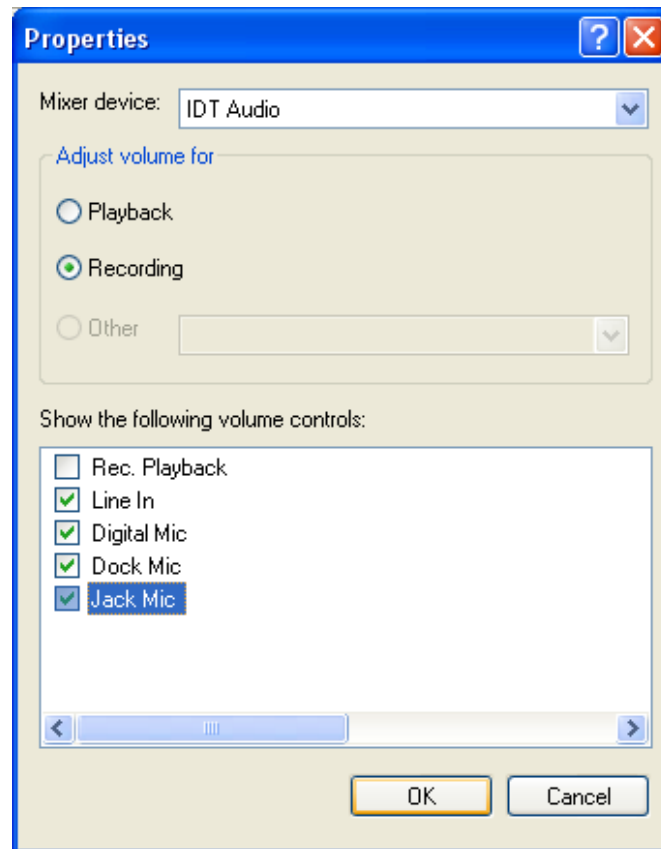


Figure 3-5: recording properties

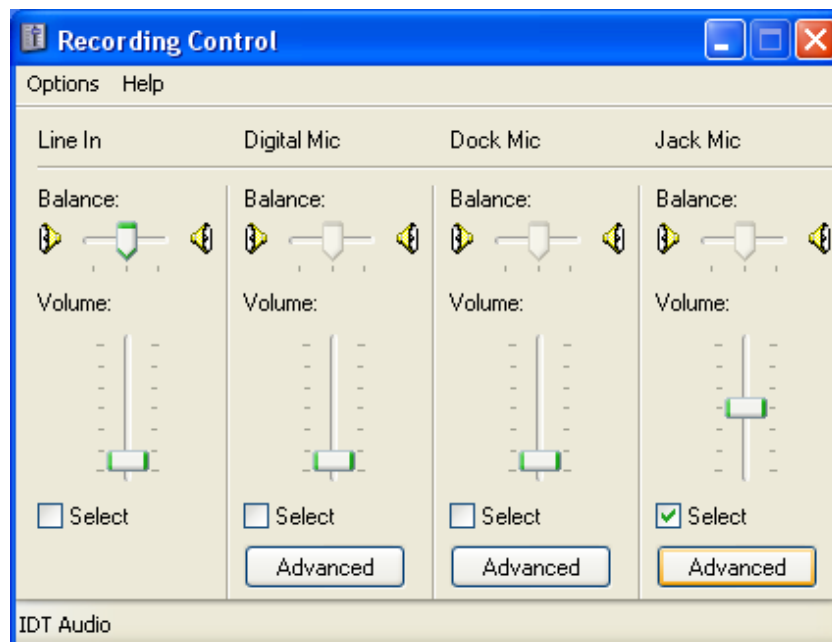


Figure 3-6: recording controller

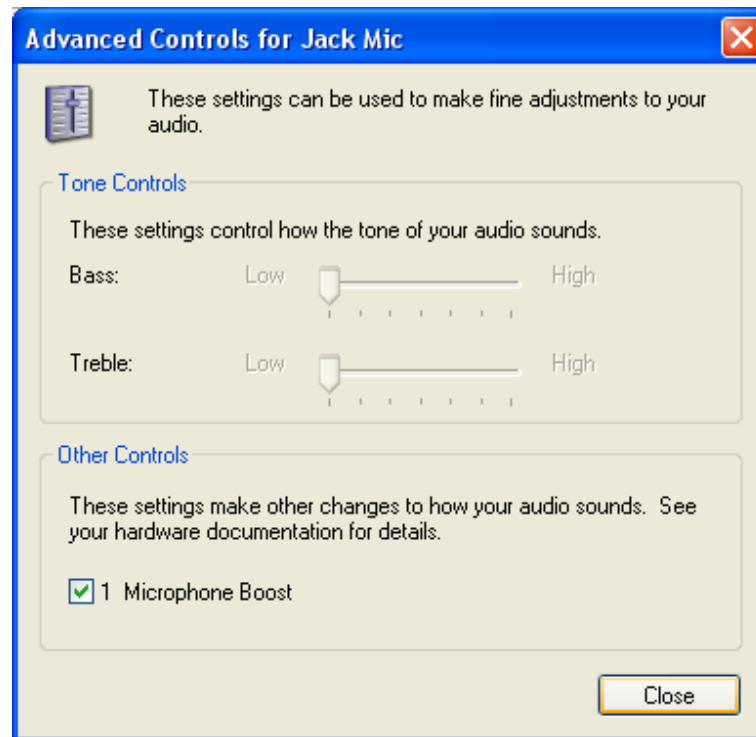


Figure 3-7: expanded microphone connection settings

### *Images from the eye and field camera are swapped over*

Swap over the BNC plugs on the cable box and the transmitter.

### *The Dikablis Wireless video transfer quality is not satisfactory*

Check that the transmitter and receiver are both set to the same frequency channel. Switch both devices to a different channel (the transmitter and receiver must always have the same channel). Change the position of the antennae. To ensure good coverage, they should be as far away from one another as possible and point upwards. There must also always be visual contact between the transmitter and antennae. Check the capacity of the battery used for supplying the power to the transmitter and replace it with a fully charged battery if necessary.

### *Where is the cross-hair?*

If you cannot see the cross-hair, the "Eye Detection" check box could be active. Recheck your pupil detection settings!

### *The cross-hair is not aligned with the pupil. How can I correct this?*

Readjust the pupil detection once again. Try to frequently use the "Eye Diameter Control" feature.

### *The pupil cannot be detected on a test person wearing make-up*

Preferably, the tests should be performed using test persons who are not wearing make-up. Under infrared light, the images of both the eye make-up and the pupil are black. This causes the system to have trouble detecting the pupil.

Use the mask setting to exclude the eyelash area from the pupil detection (see section 2.3.13 "Pupil Detection Configuration").

## 4 Glossary

### ***Adapter cable***

Cable which sets up a connection between the frame grabbers in the recording computer and the video cable.

### ***Task interval***

Time window which displays a task to be carried out in the eye tracking experiment. It is recorded by marking the start and end of the task.

### ***Eye camera***

The camera attached to the head unit which films the test person's left eye. The camera can be positioned manually using a flexible cable.

### ***Recording computer***

Computer supplied with the eye tracking system with pre-installed hardware and software.

### ***Recording software (also referred to as the Dikablis recorder or simply recorder)***

Application for recording the glance data.

### ***Analysis software (Dikablis Analysis)***

Application for the subsequent adjustment of the calibration settings and pupil detection feature for an eye tracking experiment.

### ***Blending mode***

A display option for the eye tracking video in which a semi-transparent image from the eye camera is superimposed over the field camera video.

### ***Study, test, eye tracking study, eye tracking experiment***

Examination for the observation and recording of the glance behavior of a group of people with regard to a specific issue.

### ***Subject***

A person participating in a study.

### ***Cable box (in Dikablis Cable only)***

Device which receives the signals from the head unit, edits them and then passes them on to the recording computer via the video cable.

### ***Receiver (Dikablis Wireless only)***

Device which receives the glance data transmitted by wireless link and passes it on to the recording computer. Two antennae are used for the reception. Each is connected to the receiver by a cable.

#### ***Field camera***

Camera mounted at the middle of the head unit which is used for recording the surroundings. The camera lens is replaceable. The sharpness range of the camera can be adjusted by turning the lens.

#### ***Head unit***

Unit worn like a pair of glasses by the person taking part in the eye tracking experiment. Two cameras which film the eye of the test person and the surroundings are attached to the head unit.

#### ***Journal file***

Text file which is recorded together with the field and eye camera videos at the same time that the eye tracking data is recorded. It contains information about the pupil, focal point co-ordinates, the set triggers and the received network events.

#### ***LiveView***

Display window in the recording software in which the glance behavior of the test person can be observed live while the data is being recorded.

#### ***License stick***

Allows applications to be executed and contains licensing data. The corresponding stick must be connected to a USB port of a recording computer before the applications (recording software, analysis software) can be started.

#### ***Offline subject***

A subject which has been edited using the analysis software. Changes are always saved in so-called offline subjects so that the original eye tracking data is not overwritten. It is worked with in the same way as for original subject data.

#### ***Player software (Dikablis Player)***

Application for the subsequent observation of the glance data recorded using the recording software.

#### ***Transmitter (Dikablis Wireless only)***

Device which receives glance data from the head unit and transmits it by wireless link to the receiver.

#### ***Triggers***

Triggers are used for marking particular events. For the manual analysis of the eye tracking data.

#### ***Video cable***

Cable for transmitting the video signals from the eye and field cameras. Is connected between the cable box and the adapter cable.

## 5 Dikablis Network Interface and Expanded Functions

The Dikablis Recorder can be addressed by a client via a configurable TCP/IP port. The communication is line-by-line.

The following functions can be addressed and are described in Table 5-1:

- Login
- Version information
- Status
- Create project
- Create subject
- Opening existing project/subject
- Call project list
- Call current project
- Call subject list from current project
- Call current subject
- Start/stop recording:
- Time stamp reset
- Set event
- Receive journal data

An example of a communication protocol is shown in Figure 5-1.

### 5.1 Configuration

The network functions can be configured in the global configuration file "settings.xml". This file can be found in the folder c:/Programs/Dikablis/Recorder.

The communication takes place as standard via port 2001. This is the master port which also receives network commands. There is also an option of receiving journal data via a second (slave) port (from version 2.0). This is normally port 2002. It is not possible to send commands to Dikablis via this slave connection. The port numbers can be changed in the configuration file.



```
<settings>
...
  <recorder>
    ...
      <remote>
        <enabled>true</enabled>
        <port>2001</port>
        <user>user</user>
        <pass>pass</pass>
        <journal>permanent/recording/never</journal>
        <slaveport>2002</slaveport>
      </remote>
    ...
  </recorder>
...
</settings>
```

## 5.2 Journal Data

It is possible to send the journal entries via the open network connection. The following configuration options are available by adjusting the settings.xml file (from version 2.0):

- <journal>permanent </journal>: journal data is always transmitted
- <journal>recording </journal>: journal data is only transmitted during recording
- <journal>never</journal>: journal data is never transmitted

The standard setting is "recording".

In the previous Dikablis versions (up to and including V1.0.9), the journal data was always transmitted during data recording.

The data does not need to be confirmed. The letter "J" is inserted before each journal entry to identify it as a journal entry. The individual entries are separated by tabs.

For a detailed description of the journal data, please consult section 2.2.2 Project Structure and Saved Data.

## 5.3 Extended Functions

### 5.3.1 Mirroring the Eye Video

The eye video can be mirrored horizontally and/or vertically. The setting can be found in the "headunit\_beta.xml" file which is saved under c:/Programme/Dikablis/Recorder. Change the values of the parameters "flipx" and "flipy" to adjust how the eye video is mirrored: 0 no mirroring, 1 for

mirroring along the corresponding axis. The default setting for Dikablis is 1 for "flipx" and 0 for "flipy".

```
<headunit>  
  ...  
  <flipx>1</flipx>  
  <flipy>0</flipy>  
</headunit>
```

Table 5-1: Dikablis network commands

Name	Description	Command	Answer	From version
<b>Please note that each command must end with a CR+LF (\r\n).</b>				
Login	Test to access the system: the user name and password are defined in "settings.xml".	L<username>,<password>	Ok [Failed]	V1.0.8
Version information	To query the version number of the protocol	V	Ok <Major>,<Minor>	V1.0.8
Status query	For querying the current recorder status. Return values: <ul style="list-style-type: none"> <li>• 1 to open the project</li> <li>• 3 to open the project and subject</li> <li>• 7 to record</li> </ul>	S	Ok <Statuscode>	V1.0.8
Create project	Creates a new project. The strings are not allowed to contain any “;” symbols as these are used to separate the individual input fields.	CP<Projekt> Name>;<Manager>;<Period>;<Purpose>;<Description>  Example: CPTraining 1;Lange;June 2009;driving safety;reaction during safe driving training	Ok [Failed]	V1.0.8
Create a subject (experiment)	Creates a new subject (experiment) for the current project. The strings are not allowed to contain any “;” symbols as these are used to separate the individual input fields.	CE<Subject Name>;<Test Person>;<Experiment leader>;<Test Purpose>;<Description>  Example: CETraining 1;John Doe;Lange;driving safety;reaction during safe driving training	Ok [Failed]	V1.0.8

Name	Description	Command	Answer	From version
Open existing project/subject	Opens an existing project or subject in the Dikablis Recorder. The names indicated must be the same as the project/subject names. The strings are not allowed to contain any “;” symbols as these are used to separate the individual input fields.	O<Project Name>[:<Subject Name>]	Ok [Failed]	V2.0
Call project list	Provides a list of all of the Dikablis projects which can be found in the standard repository path.	QP	Reply: P< Projektname1> P< Projektname2> .... Ok [Failed]	V2.0
Call current project	Provides the name of the current project, if there is one.	QCP	Reply: P<Projectname> Ok [Failed]	V2.0
Call subject list from current project	Supplies a list of all subjects (experiment) for the current project.	QE	P<Subjectname1> P< Subjectname2> ... Ok [Failed]	V2.0
Call current subject	Provides the name of the current subject (experiment), if there is one.	QCE	P< Subjectname> Ok [Failed]	V2.0

Name	Description	Command	Answer	From version
Start recording	Starts recording the data on the Dikablis Recorder. A project and subject must be open before recording can be started.	Rstart	Ok [Failed]	V1.0.8
Stop recording	Stops recording the data on the Dikablis Recorder. The recording will be automatically stopped if the TCP/IP connection is interrupted.	Rstop	Ok [Failed]	V1.0.8
Reset time stamp	In the Dikablis Recorder, each recorded image is assigned a time stamp. The time stamps normally refer to the program start. This function can be used to set the time stamp to "0".	I (capital i)	Ok	V1.0.8
Mark events	Is used to mark events in the eye tracking data. An event is a string containing a maximum of 64 characters (A-Z, a-z, 0-9). Events can only be saved while the eye tracking data is being recorded.	E<string>  Example: ES01010305	Ok [Failed]	V1.0.8

Client

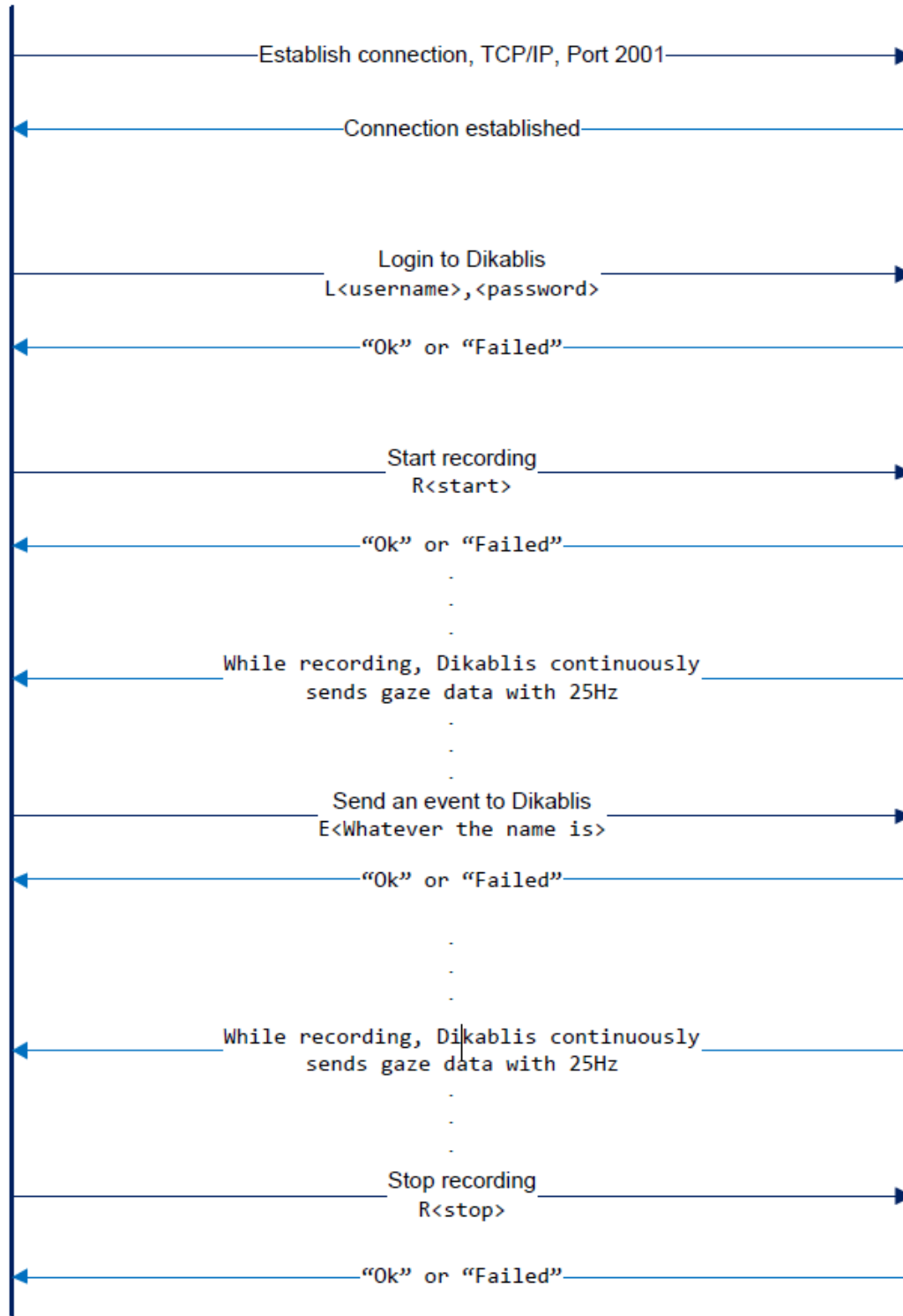



Figure 5-1: example of a communication protocol