# EyeLink® II Scene Camera User Manual

# (SceneLink Application version 1.2.1)

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# 1. Introduction

The standard EyeLink II setup allows users to record eye movements at a fixed viewing distance (e.g., computer monitor, TV, projected screen, etc). The EyeLink scene camera option provides a powerful extension so that participants' gaze position can be tracked on a real world scene video being captured from a head mounted scene camera. With horizontal disparity information from binocular recording capability of the EyeLink tracker, the scene camera option provides a build-in parallax error correction, which permits accurate gaze overlay regardless of viewing depth relative to calibration plane.

In a scene camera experiment, either a color or high resolution black and white scene camera is used to generate 30 Frames (60 fields) of scene video recording per second. The scene video is streamed to an external video overlay box, which can be used to superimpose real-time overlay graphics (current gaze position, time stamp, etc.) generated by the EyeLink II tracker on the video source. The composite output can then be displayed on a TV monitor and recorded by a VCR or DVD recorder. Alternatively, the SR Research SceneLink application can be used to save the scene camera video as digital video (in .AVI file format) without any gaze overlay graphics. A binary millisecond time code is written to every scene camera field to allow for excellent synchronization between the EyeLink gaze data and scene video. The SceneLink application is used to merge these two sources of data to create overlay graphics during playback.

This manual is for use with the EyeLink scene camera option together with the SceneLink application. Please send all bug reports and comments to SR Research Ltd (support@sr-research.com).

# 2. EyeLink II Tracker Application: Scene Camera Components

The *EyeLink* II tracker interface consists of a set of setup and monitoring screens, which may be navigated by means of the host PC mouse, shortcut keys, or from the display PC application via link commands. The EyeLink host application has been modified so that a scene camera recording can be performed. The current chapter serves as a supplement to the "EyeLink II User Manual" and only highlights those operations and components that are relevant to the use of scene camera option on the EyeLink II host application.

## *2.1 Camera Setup Screen*

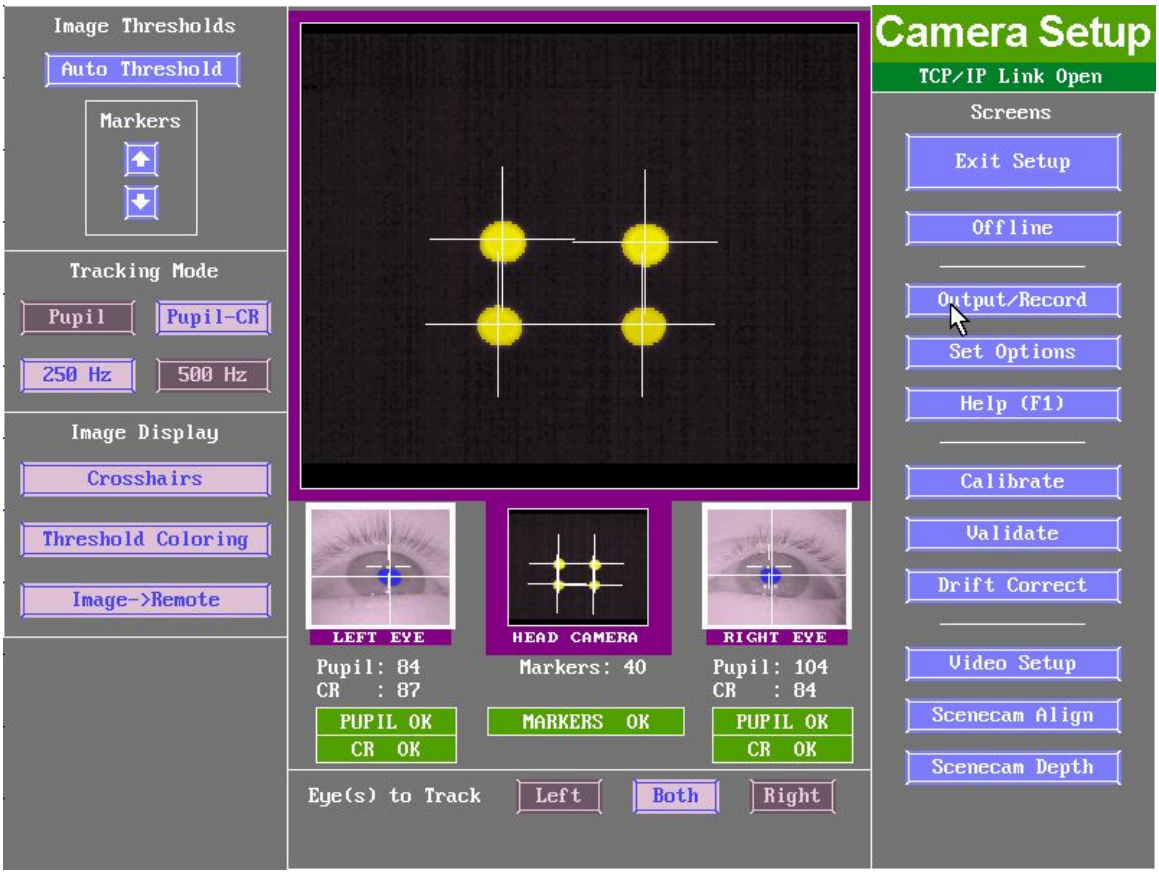


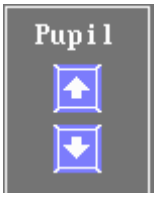
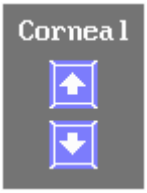
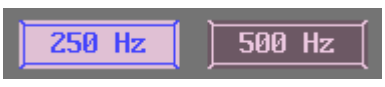

***Figure 2-1: EyeLink II Camera Setup Screen***

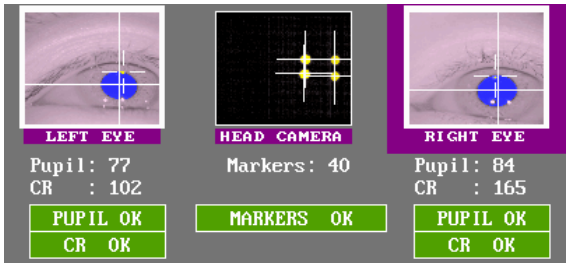
### *2.1.1 Purpose*

This is the central screen for most EyeLink II setup functions. From this screen (see Figure 2-1) the eye and head tracking cameras can be set up, and their images can be thresholded. Eye(s) to be tracked, tracking mode and options can also be set. Calibration, validation, drift correction, and scene camera

operations (e.g., video setup, camera alignment, and depth correction) can also be performed from this screen.

### 2.1.2 Main Functions

| | |
|---|---|
|  | Press Auto Threshold to threshold the selected camera image. In most cases auto thresholding will set the correct image threshold for the camera.<br>Keys: A = Auto threshold selected image |
|  | Use the arrow buttons to manually increase or decrease the selected camera's pupil threshold.<br>Keys: ⇑ and ⇓ = increase and decrease threshold |
|  | If available, use the arrow buttons to manually increase or decrease the selected camera's corneal threshold.<br>Keys: + and - = increase / decrease corneal reflection threshold |
|  | If available, use the arrow buttons to manually increase or decrease the head camera threshold.<br>Keys: ⇑ and ⇓ |
|  | Select the tracking mode for recording. Here the Pupil-Corneal Reflection mode is selected.<br>Keys: P toggles Pupil only or Pupil-CR mode selection |
|  | Select the sampling rate for recording. Here 250 Hz is selected. Note that in Pupil-CR mode, 500Hz is not available.<br>Keys: F = toggles sampling Frequency selection |
|  | Toggles display of crosshair in eye camera images.<br>Keys: X = toggle crosshair display |

| | |
|---|---|
|  | Toggles display of threshold coloring in eye camera images.<br>Keys: T = toggle threshold coloring display |
|  | Select to present the camera display image on the Display Monitor. |
|  | To select the camera to display as a large image click on the desired image thumbnail. The selected image thumbnail has a heavy border around it. Here the Right Eye camera is selected. Image thresholds and status are indicated below each thumbnail.<br>Keys: ⇐ and ⇒ to move left or right on image row |
|  | Select the eye(s) to track during recording. Here the Right eye is selected. Press the "Lock Tracked Eye" button to lock the current selection on the display PC.<br>Keys: R = select Right Eye<br>L = select Left Eye<br>B = select Both Eyes |
|  | Press Exit Setup to go to the screen that was available prior to accessing the Camera Setup window.<br>Keys: ESC = exit camera setup |
|  | Press Offline to be returned to the EyeLink II offline screen.<br>Keys: ESC = go to Offline screen |
|  | Select Output / Record to go to the output screen, from which you can start a manual recording session. This button is usually only accessed when using the EyeLink II in standalone mode.<br>Keys: O = go to Output screen |

| | |
|---|---|
|  | Select Set Options to go to the EyeLink II options screen, where a variety of system options and settings can be configured. Note that any value on this screen can be programmatically overridden by the API during experiment setup.<br>Keys: S = go to Set options |
|  | Press Help (F1) to access the online help page for Camera Setup. All available key shortcuts are also listed on the Help screen.<br>Keys: F1 = open Help screen |
|  | Select Calibration to go to the Calibration screen. After setting up the eye cameras and thresholding, you need to Calibrate the system.<br>Keys: C = go to Calibrate screen |
|  | Select Validation to be taken to the Validation Screen. Validation allows you to get a sense of the gaze position accuracy of your Calibration. Validation should always be run after Calibration.<br>Keys: V = go to Validate screen |
|  | Select Drift Correction to go to the Drift Correction Screen. Drift Correction can be performed before and during an experiment; allowing gaze position to be realigned if headband slippage or significant pupil size change has increased gaze calculation error.<br>Keys: D = go to Drift correction screen |
|  | Perform video overlay or scene camera setup. This is used to ensure accurate gaze position mapping onto the overlay device. If video alignment is not properly carried out, the accuracy of |

| | |
|---|---|
| | gaze on overlay will be negatively influenced.<br>Keys: W = go to Video Setup screen |
|  | Perform alignment between the scene camera and head camera. This must be done anytime the relative position between the scene camera and the head camera changes.<br>Keys: Y = go to Scene Camera Alignment screen |
|  | Perform correction to the gaze cursor drawing in the overlay display to improve accuracy for recordings that track eye movements at uncalibrated depths. Please note it is only possible to perform depth correction for a binocular recording.<br>Keys: Z = go to Scene Camera Depth Setup screen |

### *2.1.3 Key Shortcuts*

| **Key** | **Function** |
|---|---|
| ⇐ and ⇒ | Select between left eye camera, head camera and right eye camera. |
| R | Select Right eye for recording |
| L | Select left eye for recording |
| B | Select both eyes for recording |
| P | Toggle Pupil only or Pupil-CR mode selection |
| F | Toggle sampling frequency selection |
| A | Auto threshold selected image |
| X | Toggle crosshair display |
| T | Toggle threshold coloring display |
| ⇑ and ⇓ | Increase and decrease threshold |
| C | Go to the Calibration screen |
| V | Go to the Validate screen |
| D | Go to the Drift correction screen |
| O | Go to the Output screen |
| S | Go to Set Options page |
| F1 | Open the Help dialog, in the help screen there is a brief overview of the role of this page and the key functions for it |
| W | Go to the Video Setup screen |

| | |
|---|---|
| Y | Go to the Scene Camera Alignment screen |
| Z | Go to the Scene Camera Depth Setup screen |

## 2.2 Video Setup Screen

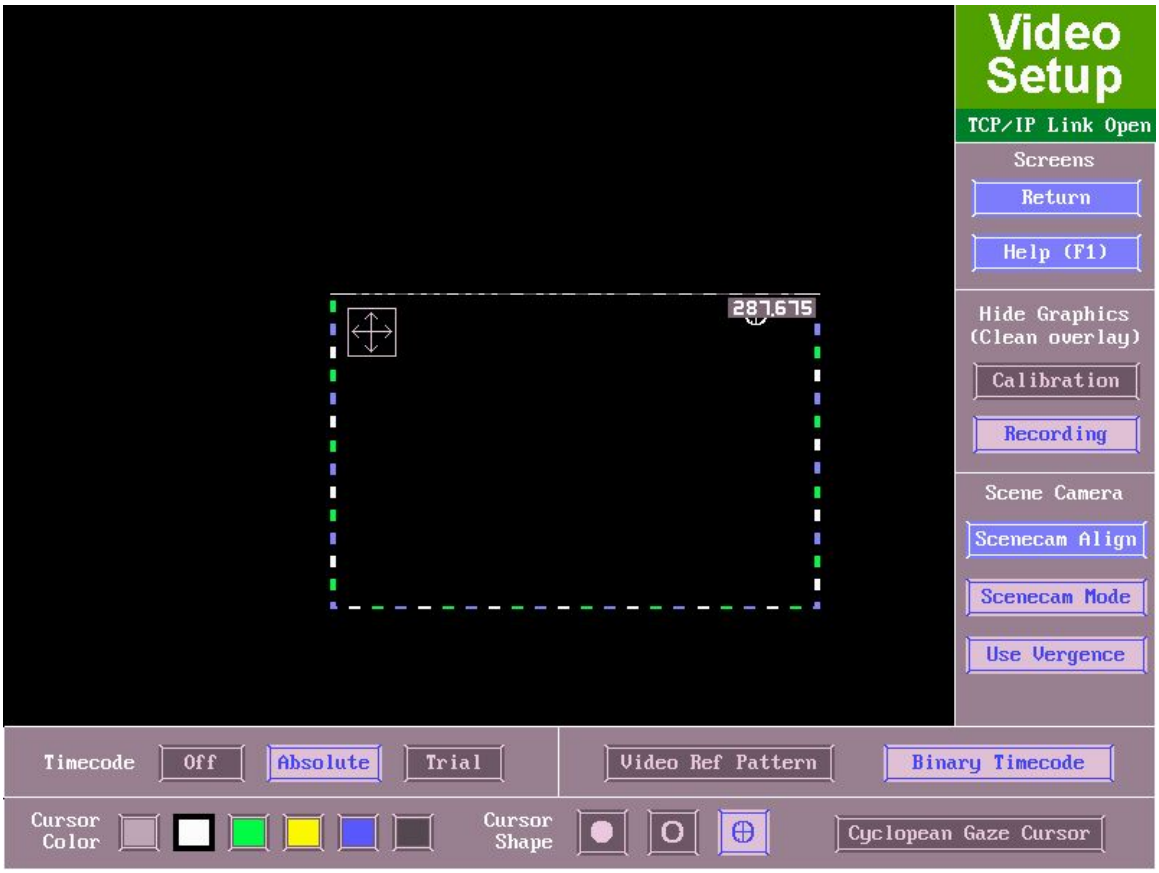


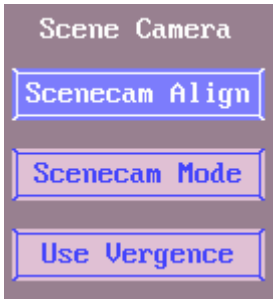

***Figure 2-2: EyeLink II Video Setup Screen***

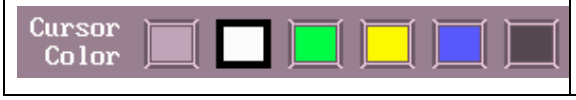
### 2.2.1 Purpose

This screen (Figure 2-2) is used to perform video overlay or scene camera setup. This is essential to ensure accurate gaze position mapping onto the scene camera overlay display.

### 2.2.2 Main Functions

| | |
|---|---|
|   | Press Return to the EyeLink II tracker setup screen.<br>Keys: Enter = return to camera setup |
|   | Press Help (F1) to access the online help page for Camera Setup. All available key shortcuts are also listed on the Help |

| | |
|---|---|
| | screen.<br>Keys: F1 = open Help screen |
|  | If "Calibration" button is disabled, additional feedback values are printed out on the overlay graphics during validation.<br><br>If the "Recording" button is disabled, the user-drawn graphics can be drawn on the host PC screen and therefore displayed behind the gaze cursor during recording. These graphics may aid analysis or serve illustrative purposes.<br><br>Keys:<br><br>X = Toggle feedback/cursors in calibration/validation screen.<br><br>R = No user-drawn graphics in recording |
|  | These buttons are related to the scene camera setup operations.<br><br>"Scenecam Align": Pressing this button will take the use to the Scene Camera Alignment Screen (see section 4.3 for details).<br><br>"Scenecam Mode": If enabled, will apply adjustments to the gaze cursor position in the overlay graphics, taking into consideration the scene camera alignment settings, as well as the camera distortion correction. This mode should be enabled for a recording using the scene camera for tracking gaze positions involving different scene depths. With a recording using the standard overlay mode, "Scenecam Mode" button should be disabled – as a result, the "Scenecam Align" and "Use Vergence" buttons will also be disabled on the camera setup screen.<br><br>"Use Vergence": If enabled, depth |

| | |
|---|---|
| | correction, if available, will be applied to the gaze positions in the overlay graphics.<br><br>Keys: S = Scene Camera cursor mapping in recording;<br><br>D = Enable/Disable scene camera depth correction.<br><br>Y = Go to the scene camera alignment screen. |
|  | The timecode may be set to “Absolute”, which displays the actual tracker time in milliseconds that is used for the timestamps for samples, events, and messages recorded in the EDF file or as real-time link data. If the “Trial” mode is selected, the timecode displays the milliseconds elapsed since the start of the trial. No timecode will be shown if “Off” is selected.<br><br>Keys: T = Select timecode type |
|  | “Video Ref Pattern”: Will be used by future scene camera AVI saving application to provide proper alignment between the AVI file and eye tracker video overlay.<br><br>“Binary Timecode”: Turns on/off the binary timecode, which represents the machine-readable EDF time. This will be used in the future AVI saving application for millisecond-accuracy alignment between the AVI clip and the EDF timing.<br><br>Keys:<br><br>V = Show video alignment pattern;<br><br>M = Toggle on/off the machine-readable timecode line |
|  | Several cursor colors can be selected from the Video Setup screen, the most |

| | |
|---|---|
| | useful of which are yellow and white.<br>Keys: C = Gaze cursor color. |
|  | Gaze cursors for use in the video overlay have a selectable shape, which may improve visibility. Cursors may either be a solid circle, a hollow circle, or a hollow circle with a cross in the center.<br>Keys: G = Gaze cursor type |
|  | If enabled, draws a single gaze cursor, representing the average of the two eyes. If disabled, gaze cursors are drawn separately for each eye.<br>Keys: B = Binocular or Cyclopean cursor |

### *2.2.3 Key Shortcuts*

| **Key** | **Function** |
|---|---|
| G | Gaze cursor type |
| C | Gaze cursor color |
| T | Timecode type |
| X | No feedback cursors in the calibration/validation screen |
| R | No user-drawn graphics in recording |
| S | Scene Camera cursor mapping in recording |
| V | Show video alignment pattern (setup only) |
| M | Show machine-readable timecode line |
| B | Binocular or Cyclopean gaze cursor |
| Arrow keys | Move the selected corner of the overlay window |
| Tab | Toggle the corner of overlay window to move |
| F9 | Reset overlay window to default position |
| Enter / ESC | Return to Set Options screen |
| F1 | HELP (this screen) |

## 2.3 Scene Camera Alignment Screen

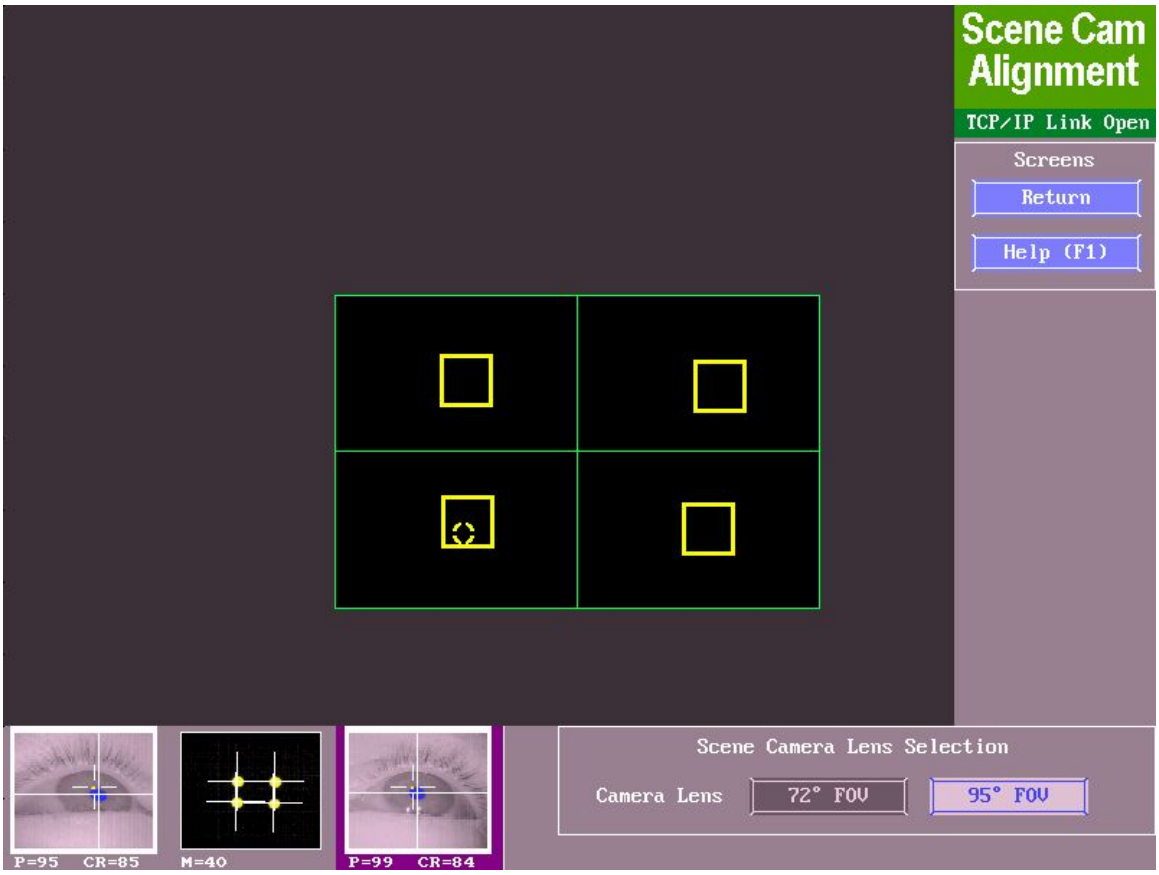



***Figure 2-3: EyeLink II Scene Camera Alignment Screen***

### 2.3.1 Purpose

This screen (Figure 2-3) is used to align the scene camera to the head camera. This is done by selecting the proper lens type, then using the mouse to place the four boxes around the four IR markers on the calibration monitor. The alignment should be done anytime the relative position of the scene camera changes from the head camera (see section 4.3 for details).

### 2.3.2 Main Functions

| | |
|---|---|
|  | Press Return to the EyeLink II tracker setup screen.<br>Keys: Enter = return to camera setup |
|  | Press Help (F1) to access the online help page for Camera Setup. All available key shortcuts are also listed on the Help screen. |

| | |
|---|---|
| | Keys: F1 = open Help screen |
|  | This allows the user to select the camera lens type. Make sure this setting matches exactly with the actual type of lens installed in the scene camera.<br>Keys: L = Select the scene camera lens type |

### *2.3.3 Key Shortcuts*

| **Key** | **Function** |
|---|---|
| L | Select the scene camera lens type; |
| Enter / ESC | Return to Set Options screen |
| F1 | HELP (this screen) |

## *2.4 Scene Camera Depth Setup Screen*

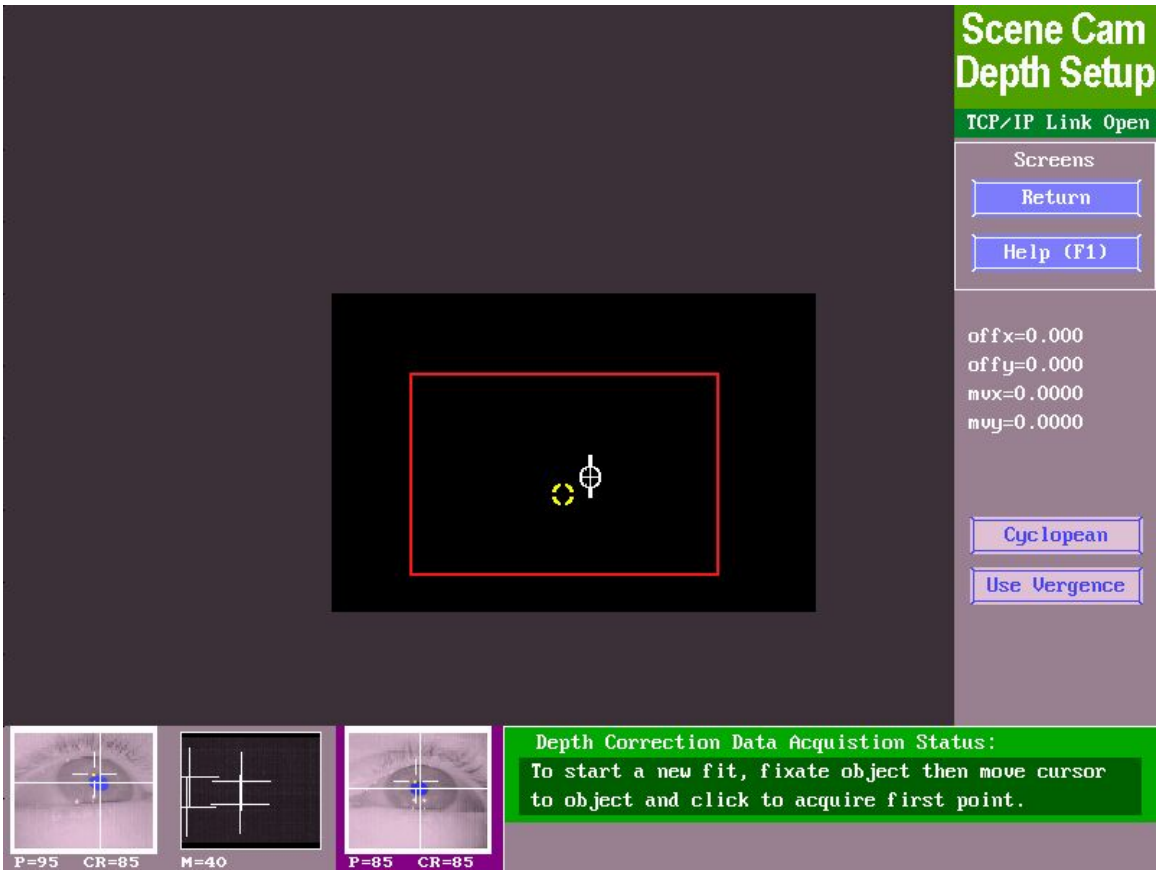


*Figure 2-4: EyeLink II Scene Camera Depth Setup Screen*

### 2.4.1 Purpose

This screen (Figure 2-4) is used to correct for depth parallax (i.e., inaccuracy in the gaze cursor drawing) in the scene camera overlay caused by the separation between the participant's eye and the scene camera. If both eyes are being tracked, the binocular data can be used to correct at other viewing depths. This screen allows the experimenter to collect several extra fixations on targets presented at significantly different depths (see section 4.6 for full details).

### 2.4.2 Main Functions

| | |
|---|---|
|  | Press Return to the EyeLink II tracker setup screen.<br>Keys: Enter = return to camera setup |
|  | Press Help (F1) to access the online help page for Camera Setup. All available key shortcuts are also listed on the Help screen.<br>Keys: F1 = open Help screen |
|  | If enabled, draws a single gaze cursor, representing the average of the two eyes. If disabled, gaze cursors are drawn separately for each eye.<br>Keys: B = Binocular or Cyclopean gaze cursor |
|  | If enabled, depth correction, if available, will be applied to the gaze positions in the overlay graphics (see section 4.5 for details).<br>Keys: D = Enable/Disable vergence-based depth correction for gaze cursor drawing. |
|  | If pressed, this will clear all of the data points collected for depth adjustment.<br>Keys: R = Restart collection (clear data). |
|  | If pressed, this will keep the existing data points collected and improve upon |

| | |
|---|---|
| | the last fit by adding more data points. Note that this button will only be visible following an initial depth correction.<br><br>Keys: I = Improve last fit. |
|  | If pressed, this will abandon the newly collected data points and revert to the previous parameters. By clicking this button again, both the previous data points and the more recent data points collected will be kept. Note that this button will only be visible following an initial depth correction.<br><br>Keys: V = Revert to last entry or restart. |

### *2.4.3 Key Shortcuts*

| **Key** | **Function** |
|---|---|
| Enter / ESC | Return to Set Options screen |
| F1 | HELP (this screen) |
| B | Binocular / Cyclopean cursors |
| D | Enable/Disable vergence correction |
| R | Restart collection (clear data) |
| I | Improve last fit |
| V | Revert to last entry or restart |

## 2.5 Record Screen

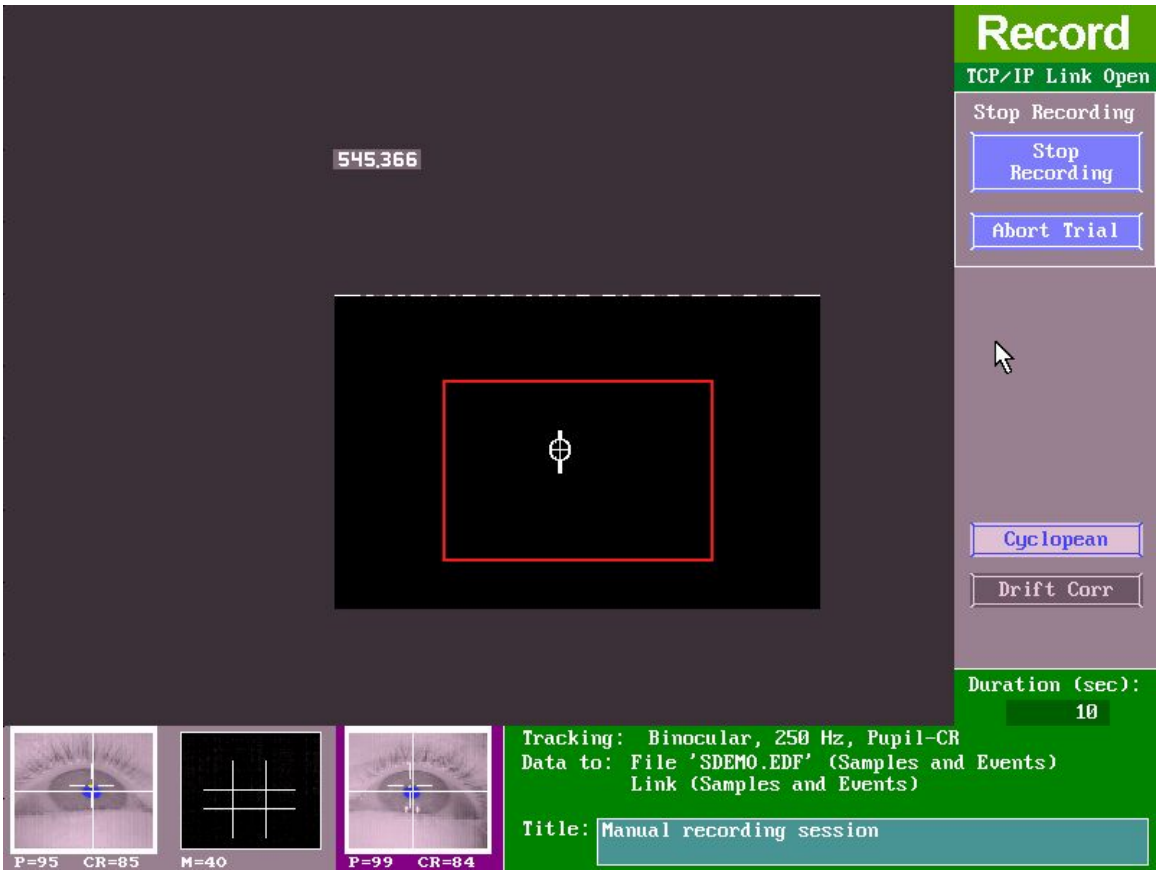



*Figure 2-5: EyeLink II Record Screen*

### 2.5.1 Purpose

A menu of options allows opening and closing (EDF) files, setting data to be recorded, and other output-related options. This mode (see Figure 2-5) always precedes manual entry into Output mode, to allow parameter preview.

### 2.5.2 Main Functions

| | |
|---|---|
|   | Stops the recording of data to the EyeLink Data File.<br>Keys = ESC |
|   | If enabled, draws a single gaze cursor, representing the average of the two eyes. If disables, gaze cursors are drawn separately for each eye.<br>Keys: B = Binocular or Cyclopean gaze |

| | |
|---|---|
| | cursor |
|  | If this button is pressed, an online drift correction can be performed (see section 4.8 for full details).<br>Keys: F = Online offset correction; |

### *2.5.3 Key Shortcuts*

| | |
|---|---|
| ESC | Exit to output screen |
| CTRL + ALT + A | Abort trial menu |
| F | Online offset correction |
| B | Cyclopean binocular display |
| **After Trial Aborted** | |
| S | Setup (Calibrate, camera setup) |
| R | Repeat Trial |
| N | Next Trial |
| CTRL + ALT + T | Terminate Experiment |
| CTRL + ALT + Q | Terminate program |

# 3. Setting up and Configuring the SceneLink Application

The current chapter goes through the hardware and software installation before the scene camera option can be used. It also contains trouble shooting information on the common problems in using the SceneLink application.

## *3.1 System Requirements*

The following items are required to perform a scene camera EyeLink experiment with the SceneLink application:

- A VGA overlay device (AVT-3170 Scan Converter, i.e., "Overlay Box") supplied by SR Research, including necessary cabling.
- Scene cameras (with cables and power supply) supplied by SR Research.
- An advanced digital video converter (Canopus ADVC 55, 100, or 110), including the necessary cabling (a IEEE 1394 cable and a S-Video or composite video cable). Power supply is also supplied for ADVC 100/110 converter and for ADVC 55 converter if a laptop is used as the display PC. Please note that ADVC 100 or 110 is required for scene camera recordings with audio.
- A fast display computer (2.0 GHz or faster CPU and at least 512 MB RAM) with two large hard disks installed. One of the hard disks (120 GB or more disk space with 7,200rpm) is solely devoted for scene camera video saving, as we need about 1 Gigabyte of hard disk space for each 5 minutes of video recording. Note that the hard disk must be de-fragmented and preferably formatted in NTFS file system with the largest block size.
- The display computer must also have a reasonably good video card installed with at least 64 Megabyte of video memory. Known supported video cards include ATI 9500 Radeon and nVidia GeForce4 MX 400. Known unsupported ones include WildCat high end ones.
- The display PC must has a 6-pin or 4-pin firewire 1394 port (and driver for it if required).
- If you want to record audio data as well, make sure you have a good microphone and an amplifier.

## *3.2 Installing Scene Camera*

If the scene camera option is purchased after the base system, follow the instructions below for installing the scene camera on the headband:

- Use an SR Research supplied screwdriver to remove the four screws on the head camera bracket (see Figure 3-1).

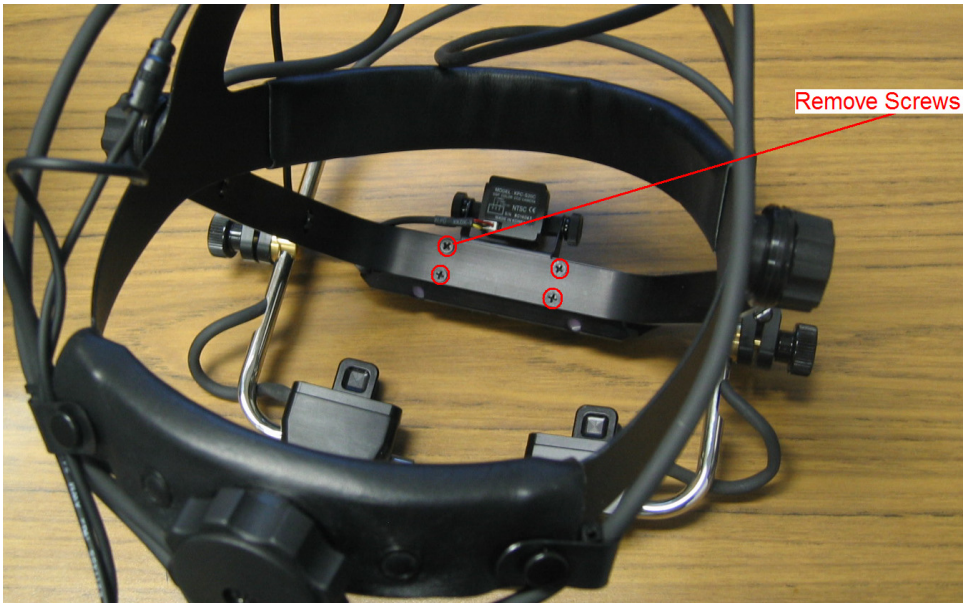



***Figure 3-1: Remove Screws on the Head Camera Bracket***

- Insert the scene camera bracket between the head camera bracket and the head camera clamp (see Figure 3-2).
- Align the holes on the head camera clamp, scene camera bracket, and the head camera bracket, and put back the screws. Plug the power adapter into the scene camera.

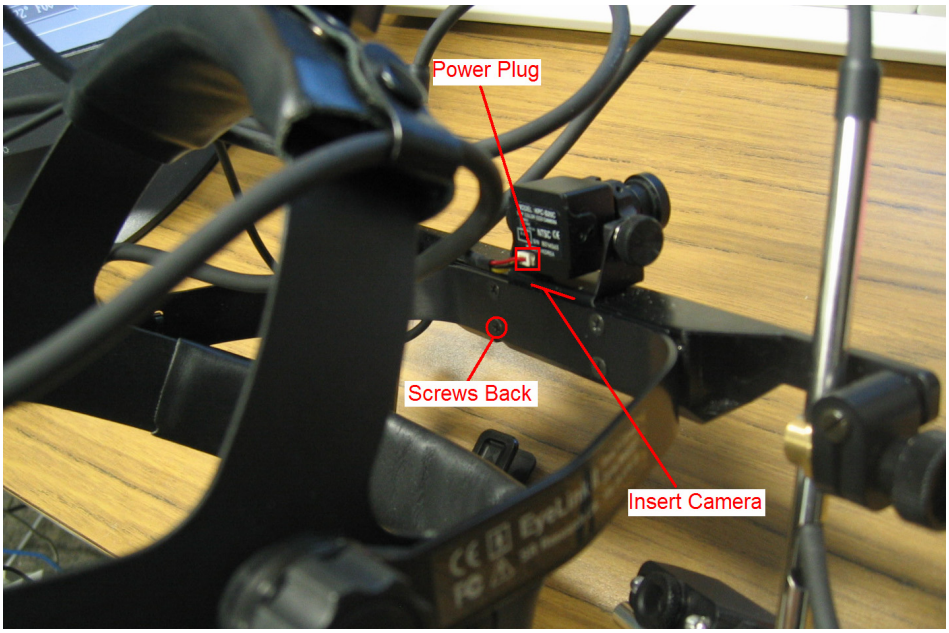


***Figure 3-2: Insert Scene Camera between the Head Camera Clamp and the Head Camera Bracket***

- Dress the cables of the scene camera with buttons on the headband frames as illustrated in Figure 3-3. Wire the scene camera cable between the headband frame and head camera cable (see A). Undo buttons B and C, put the scene camera cable through, and fasten the button back.

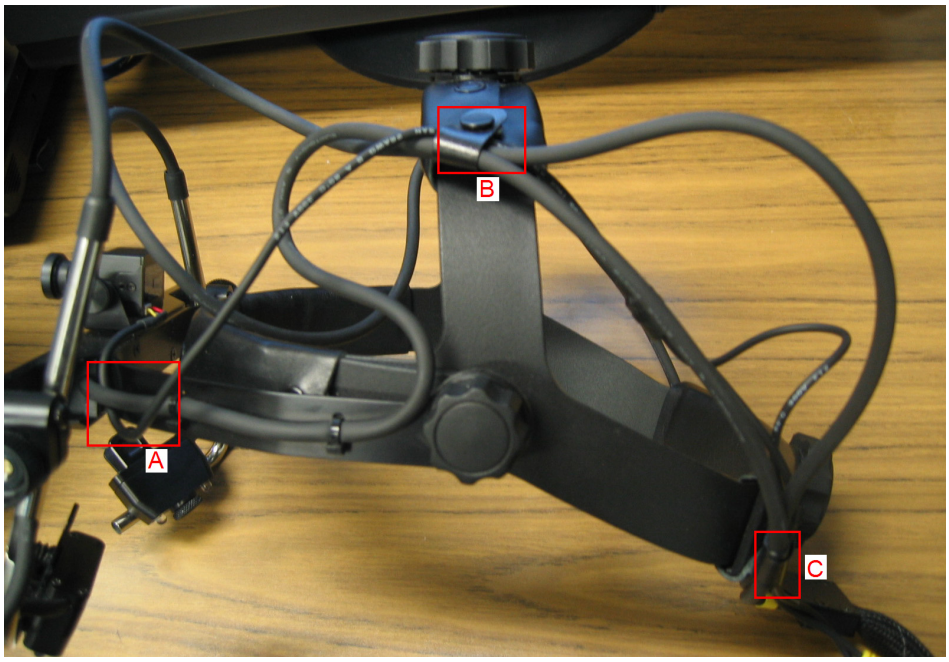



***Figure 3-3: Dress the Scene Camera Cables***

- Loosen the screws of the scene camera and angle the scene camera appropriately so that it sees as much of the scene of interest as possible, and then tighten the camera screws.

## *3.3 Wiring and Configuration*

To set up the EyeLink scene camera option, please follow the wiring diagram in Figure 3-4. The basic cabling steps are:

- Have the EyeLink base system ready. This includes the headband, marker cables, and ethernet cable setup (see section 2 “Hardware Installation” of EyeLink ® II Installation Guide).
- Set up the green AVT 3170 Overlay Box, including all cabling and settings configuration.
- Set up the ADVC Digital Video (DV) converter box.

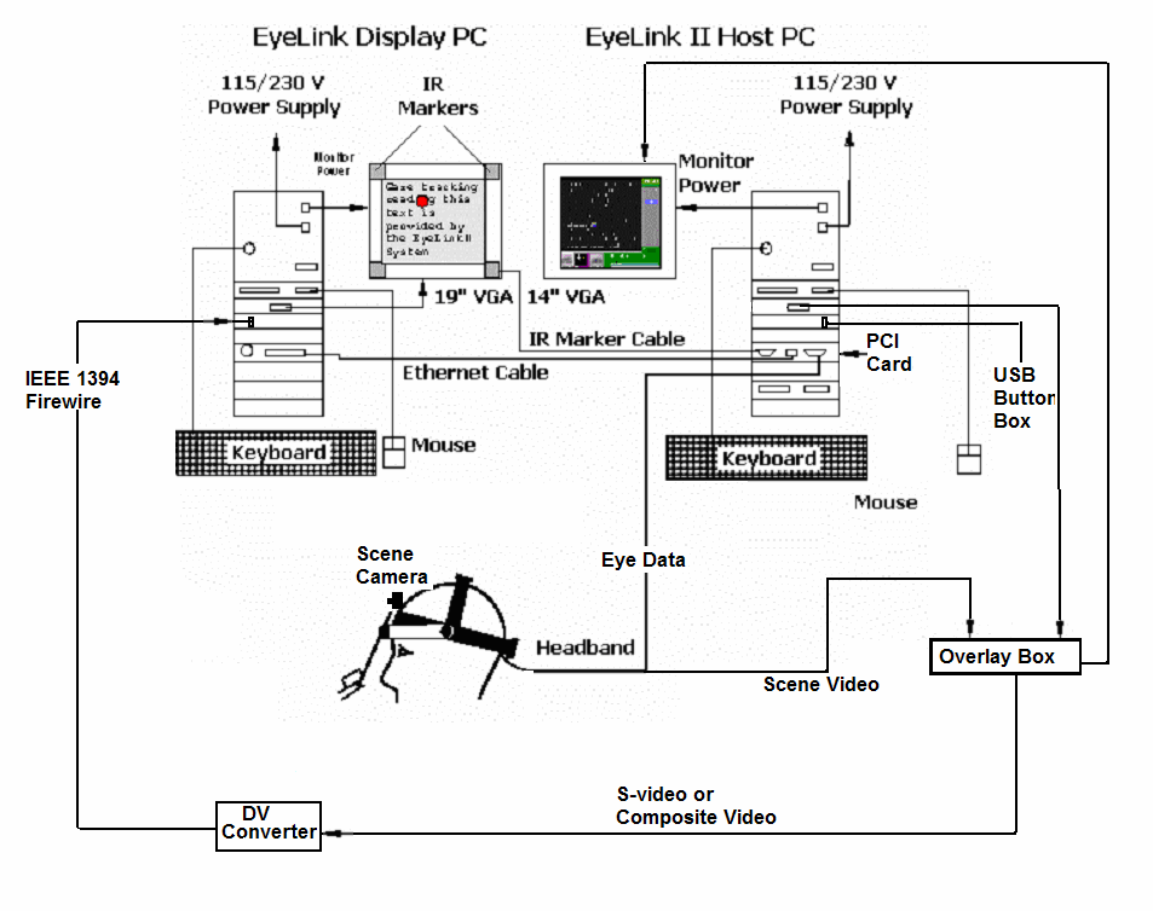



***Figure 3-4. EyeLink System Connection in a Scene Camera Recording***

### *3.3.1 Setting up the Overlay Box*

The following steps should be followed to set up the overlay box:

- Connect the "VGA-IN" of the overlay box to the VGA card of the EyeLink II host computer and "VGA-OUT" to the monitor of the host
- Next, connect the scene camera output to the overlay input and the overlay output to the Canopus DV converter box with proper cables. Figure 3-5 illustrates the connection between the RCA plug from the scene camera and the "V-IN" of the overlay box and the connection between the "S-OUT" and the S-Video input of the DV Converter.
- Plug in the power adapter of the overlay box.
- For best overlay quality, the following settings may be used:

  Overlay (Key) switch: black

  TV System: NTSC.

Video Input: S-IN (if S-Video In is used for the scene camera input);

or V-IN (if V-In is used.)

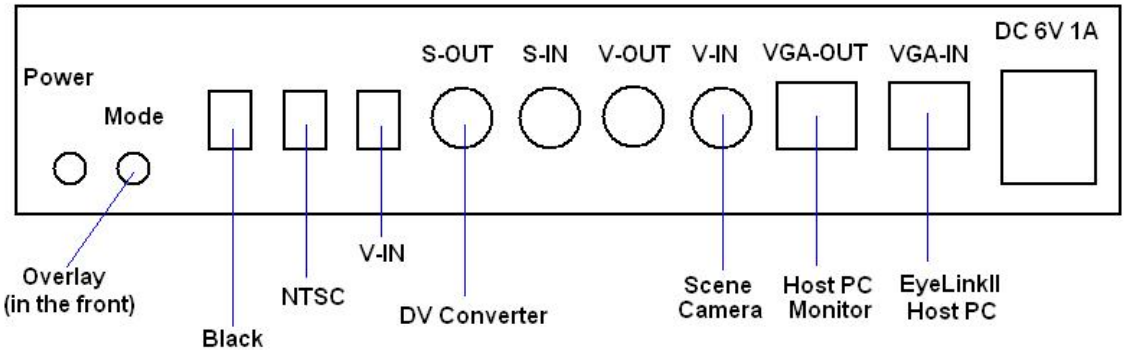



***Figure 3-5: Wiring Diagram for Scene Camera Option.***

### *3.3.2 Setting up the Digital Video Converter*

The following steps should be followed to set up the Digital video (DV) converter box:

- The "S-OUT" of the AVT-3170 overlay box should be connected to "S VIDEO IN" on the front of the Canopus ADVC converter box (or the "V-OUT" of the overlay box to the "VIDEO IN" of the DV converter if a composite video cable is used).
- Connect the IEEE 1394 firewire cable between the Canopus ADVC converter box and the display computer. If you use a laptop as the display PC, plug the larger 6-pin end into the back of the box and the smaller 4-pin end into the computer.
- If you are using the ADVC 100 Converter box or you are using a laptop as display PC, please plug in the AC adapter of the DV converter box. If you use the ADVC 55 or ADVC 110 Converter box and have a desktop as the display PC, you may use the 6-pin-to-6-pin 1394 firewire cable without the optional AC adapter. **Note: When you connect or remove the DV cable, please make sure the power of both PC and the DV converter, if used, are off. The DV converter may be damaged because of a power surge.**

### *3.3.3 Recording Audio Data*

Version 1.0 of the SceneLink application supports recording of audio data with an ADVC 100 or 110 converter (ADVC 55 is not supported). To do this, the user should connect the microphone to an amplifier; the output from the amplifier should then be connected to the L/R RCA jack at the front (or the "Audio In" minijack at the back, depending on the cable and converter used). In addition, the user should check for the settings of the mode switch selectors at

the back of the DV converter box. The switch that controls the audio mode should be set to "On" position (i.e., 32kHz/12-bit 4-channel audio). The switch that controls the "Locked Audio Mode" should be left in the "OFF" position to make sure audio stays locked to the video.

### 3.3.4 Using a Dell D-Series Laptop as Host PC

If you are using a Dell D-series laptop as the host PC on a docking station, you should also have a computer monitor connected to the docking station. Press "Fn" + F8 (CRT/LCD) so that you will have computer signal sent to both the monitor and overlay box.

## 3.4 Software Installation

Both the host PC and display PC need to be configured for use with the EyeLink II SceneLink application.

### 3.4.1 Host PC

Copy the existing EyeLink2 directory on the host PC to a new folder as a backup. Then copy the supplied files into the EyeLink2 folder (tracker version 2.0 or later). These should overwrite the eyelink2.ini and the eyelink2.exe files, and add a number of extra files (final.ini, scenecam.ini, and vidovl.ini). The vidovl.ini and scenecam.ini contain all of the settings for using the video overlay option and scene camera option respectively. If changes to these default settings are required, please copy and paste the commands to the final.ini and make the modification in that file for the ease of future maintenance. Users may also want to do a complete update of the host directory by backing up the existing directory and then using the latest version downloadable from (https://www.sr-support.com/forums/showthread.php?t=11).

### 3.4.2 Display PC

To use the SceneLink application, the display PC must be running on a 32-bit version of Windows XP (service pack 2 recommended).

- Check whether DirectX version 9.0c is installed on your computer. To check out the version of DirectX installed, from the DOS prompt type "dxdiag" or search for the "dxdiag.exe" file in the {windows}\system32 directory and click on it. This will bring up a "DirectX Diagnostic Tool" dialog box (see Figure 3-6). If an older version of DirectX was installed on your computer, the user should download the latest version from http://www.microsoft.com/windows/directx/default.mspx.

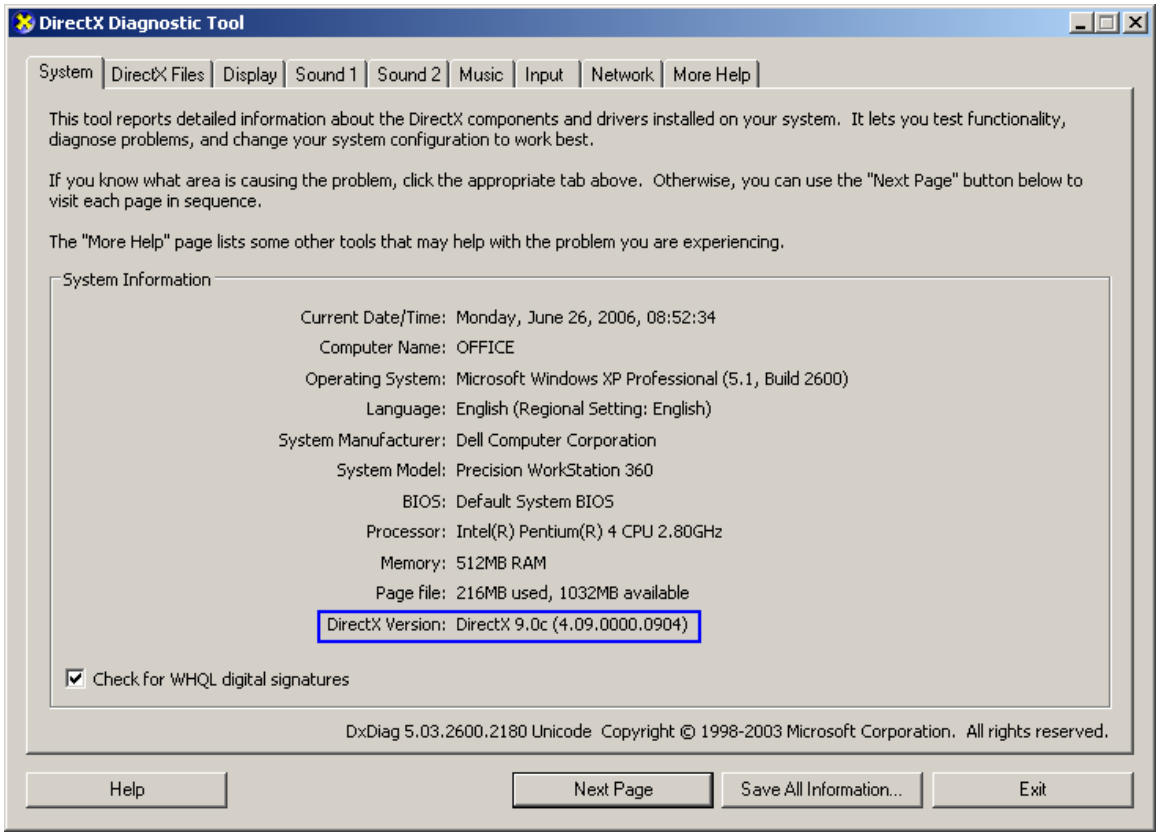



***Figure 3-6. Version of DirectX Installed on the Display PC***

- The DriverLinx parallel port driver (Port95NT.exe) should be installed if the user wants to send or receive synchronization signals through the parallel port of the display computer. The installer can be found at "C:\Program Files\SR Research\EyeLink\bin" folder if you have installed the Windows Display Software

  (https://www.sr-support.com/forums/showthread.php?t=6).

- Run the "scenelink.exe" installer supplied by SR Research Ltd with default configurations.

## *3.5 Checking Firewire Connection*

Start the EyeLink II Tracker application on the host computer. Run the SceneLink application from "Start → Programs → SR Research EyeLink → Scene Camera" of the display PC. The scene camera application should start up. If you see the following warning information (see Figure 3-7), please check:

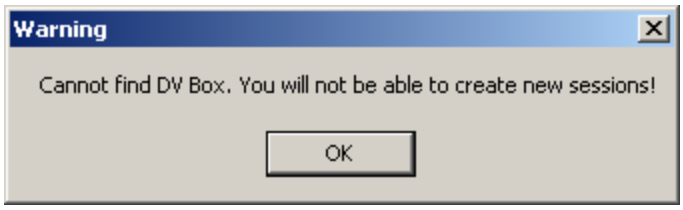



***Figure 3-7. Error in Detecting the DV Connection***

- Has a connection been made between the S-Video or composite video output of the overlay box and the input (on the front) of the Canopus DV converter box?
- Has the Canopus DV converter box been connected to the display PC with a firewire cable? If you connect the converter and a laptop with a 6-pin-to-4-pin1394 cable, has the optional AC adapter been used?
- If the error information persists, please check the Device Manager of the display computer to see whether the 1394 firewire is properly configured. If you are using Windows XP, the quickest check is to use Windows Movie Maker (from Start -> Programs -> Accessories -> Entertainment) to see whether you can get video captures from the firewire (if you are seeing black video, please read section 3.7.3).

If you decide to go ahead without fixing the above DV connection issue, the "File → Open Record Session" menu of the application will be disabled. This means that the scene camera application can be used to play back previous recordings but not perform new recordings.

## *3.6 Configuring SceneLink Options*

If this is the first time you have run the scene camera application, please check the application settings before performing a recording. Click on "View -> Preferences". In the "General" tab of the following dialog (see Figure 3-8), you will find an edit dialog for "Capture Location". This is the location where the EyeLink data (.EDF) file and scene camera video (.AVI) files are saved. The default directory setting is "{Window_drive}\Documents and Settings\{User Name}\My Documents". Users may want to create a new directory and set the capture location to that directory.

Please also check the tracker address settings in case your host PC is running at a different IP address. This is set to "100.1.1.1" by default. The "ADVC Status" field is used as a diagnostic to show the current connection and playing status of the DV converter box. If multiple audio cards installed on the display PC, the "Audio Output" setting allows the user to choose the correct audio device for audio data playback.

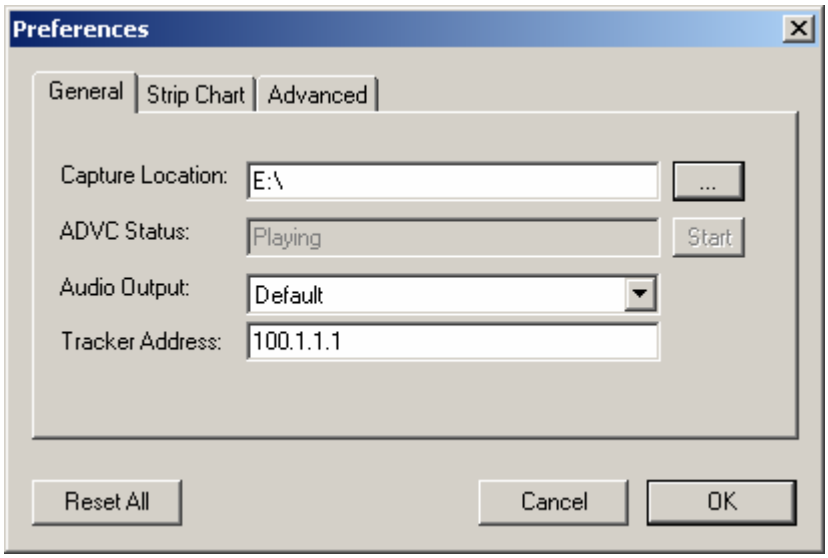



***Figure 3-8. General Tab of the Preferences Dialog Box***

The "Strip Chart" tab of the preferences dialog box (see Figure 3-9) contains settings for the strip chart display, which plots the X and Y gaze position as a function of the current tracker time (see section 4.11). The duration of the gaze history (5-30 seconds) can be adjusted from the slider bar control. The frequency of data updating (Refresh Rate in times per second), and display mode (panning or wrapping around) can also be adjusted.

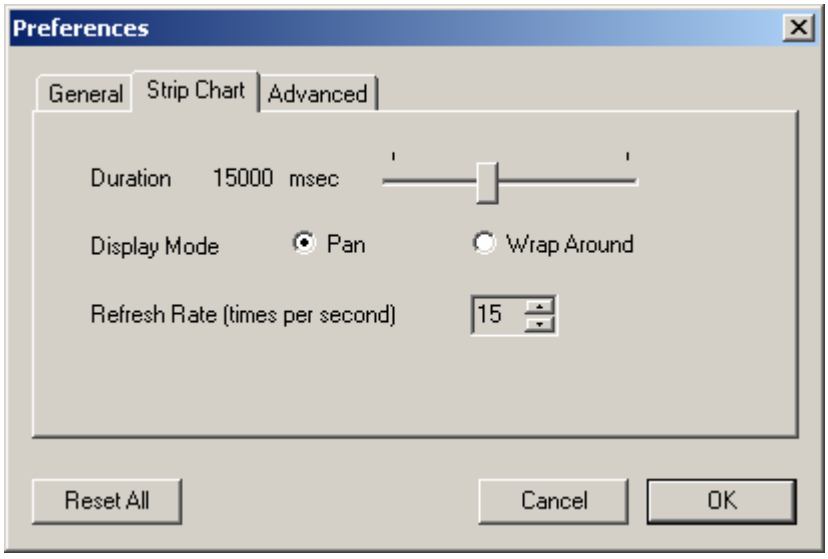



***Figure 3-9. Strip Chart Tab of the Preferences Dialog Box***

The SceneLink software can send out TTL signals to a third-party acquisition device/computer for synchronization purposes (see section "4.8.2

Synchronization with Third-Party Recording Devices"). The software can also receive incoming signals to control the start and end of scene camera recordings. The address of the port, register and value of the incoming and outgoing TTL signals can be configured in the "Advanced" tab of the preferences dialog box (see Figure 3-10). In addition, the user can set the foreground and background colors of the calibration screen.

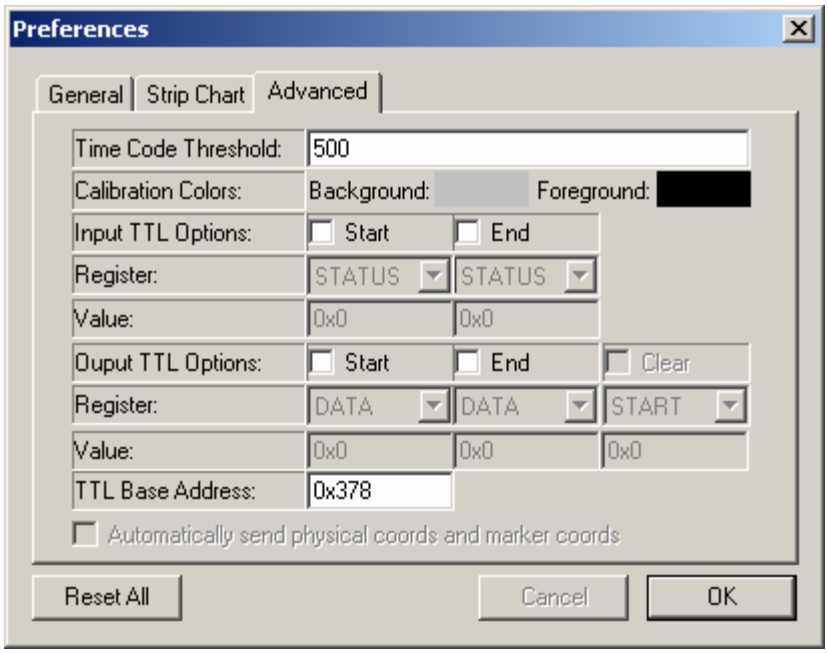



***Figure 3-10. Advanced Tab of the Preferences Dialog Box***

## *3.7 Checking SceneLink Connections and Settings*

Start the EyeLink application on the host PC. Click on "Set Options" menu. Make sure "Enable Overlay" button is enabled. Next, click on "Video Setup" button. Make sure both "Scenecam Mode" and "Use Vergence" buttons are enabled. Press button 5 of the overlay remote control to set the overlay box to 2× zoom.

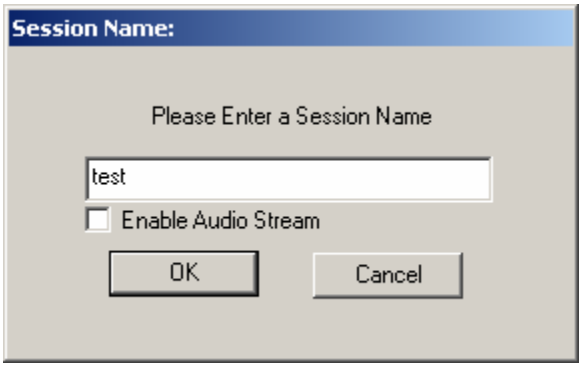


***Figure 3-11. Openning a Recording Session.***

Click on "File → Open Record Session" to start a scene camera recording session. (If this menu option is disabled, please see section 3.5 "Checking Firewire Connection".) This will bring a dialog box, prompting for a recording session name (see Figure 3-11). The recording session name should contain no more than eight ASCII characters (no space or special characters allowed). Enter the filename and press "OK" button. If you want to record audio data as well, make sure the "Enable Audio Stream" box is checked. To get better quality, you may turn the audio volume down while recording so that the high frequency noise does not occur or you do not hear an echo. You may turn the volume up when playing back the recording session.

If you see a "connection timed out" or "EyeLink Not Initialized" error message, please make sure the EyeLink II program is running on the host PC. If necessary, also check your network settings and the ethernet cable connection between the host and display PCs. If everything runs fine, the video from the scene camera should now be displayed on the main window of the SceneLink application (see Figure 3-12).

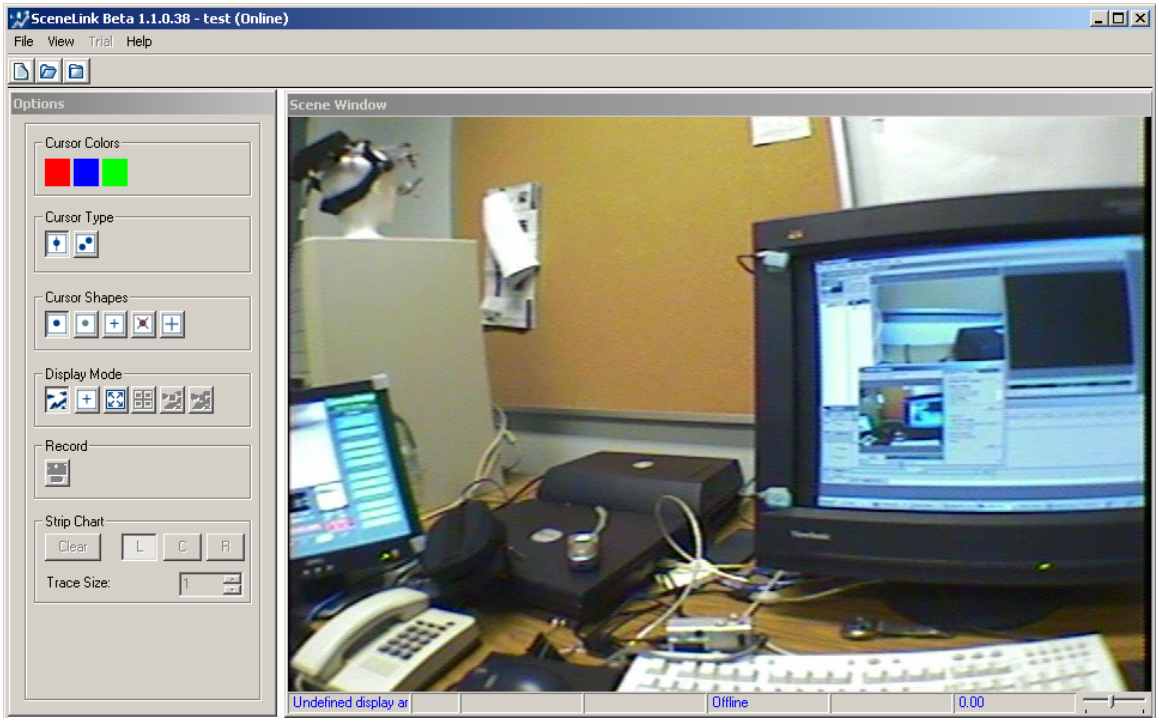



***Figure 3-12. Initial View of the SceneLink Application***

The following sections illustrate initial screens the user may see if the scene camera option is not properly set up:

- Seeing tracker graphics (section 3.7.1)

- Seeing a gray screen (section 3.7.2)
- Seeing a blank screen (section 3.7.3)

### 3.7.1 Seeing Tracker Graphics

In the video window of the SceneLink application, if you see scene camera video with graphics from the tracker program overlaid on the right and bottom edges (see Figure 3-13), it is likely that the graphics from the tracker screen is not zoomed. Press button 5 of the overlay remote control to set the overlay box to 2× zoom.

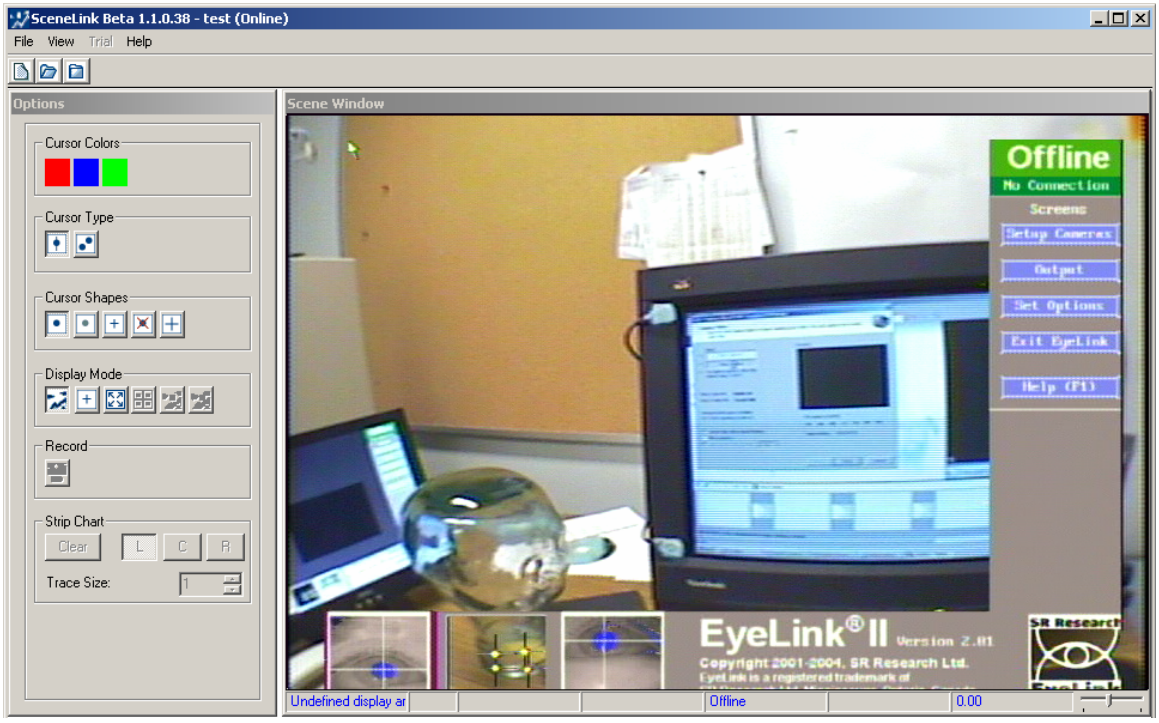



*Figure 3-13. Unzoomed Tracker Graphics*

### 3.7.2 Seeing a Gray Screen

If you see a gray screen with part of video visible at the four edges of the video window (see Figure 3-14) and you don't find "Video Setup", "Scenecam Align", and "Scenecam Depth" buttons on the Camera Setup screen of the host application (see Figure 3-15), please check the following settings:

- Go to the Set Options screen of the EyeLink II Tracker application. Make sure the "Enable Overlay" button is selected. Click on the "Overlay Setup" button. In the following video setup screen, make sure the "Scenecam Mode" and "Use Vergence" buttons are enabled.
- If you don't see the "Enable Overlay" button at the bottom right corner of the Set Options screen, quit the EyeLink host application. Do a search

on the eyelink2\exe directory for the “vidovl.ini” and “scenecam.ini” files. Make sure both files are present. Also, open eyelink2.ini to make sure the following two lines are included in the file.

```
include "vidovl.ini"        // vidovl settings
include "scenecam.ini"      // scene camera setting
```

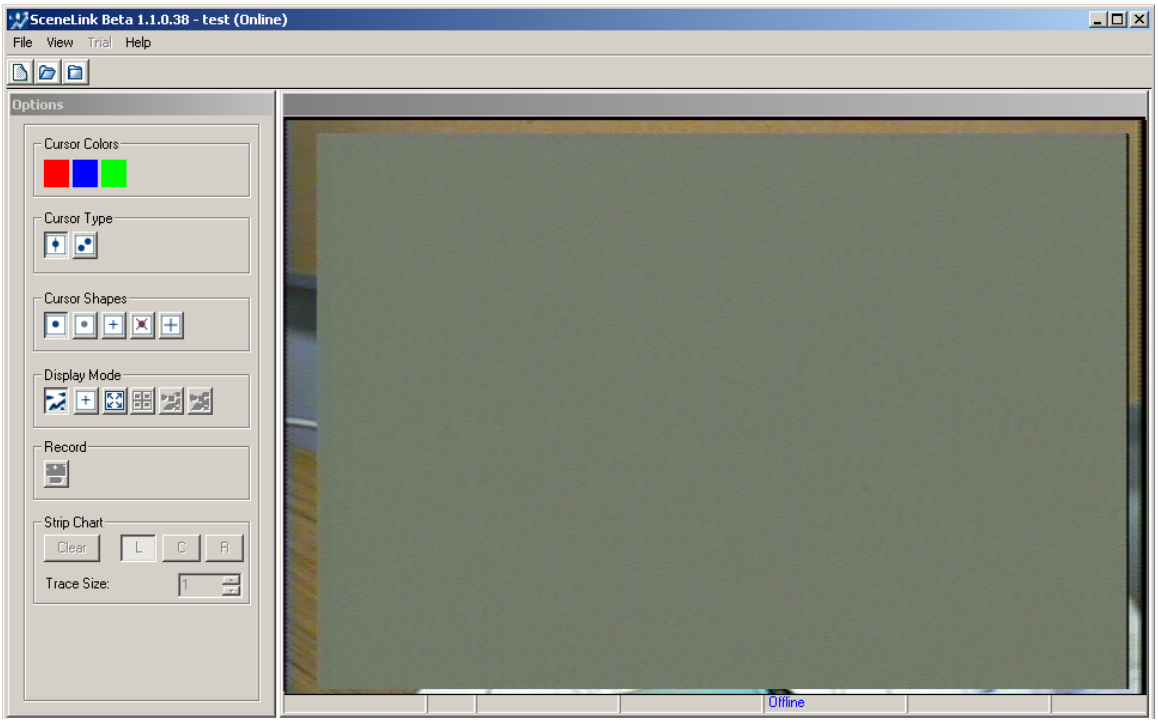



***Figure 3-14. Gray Background Over Video, Check EyeLink2 Settings***

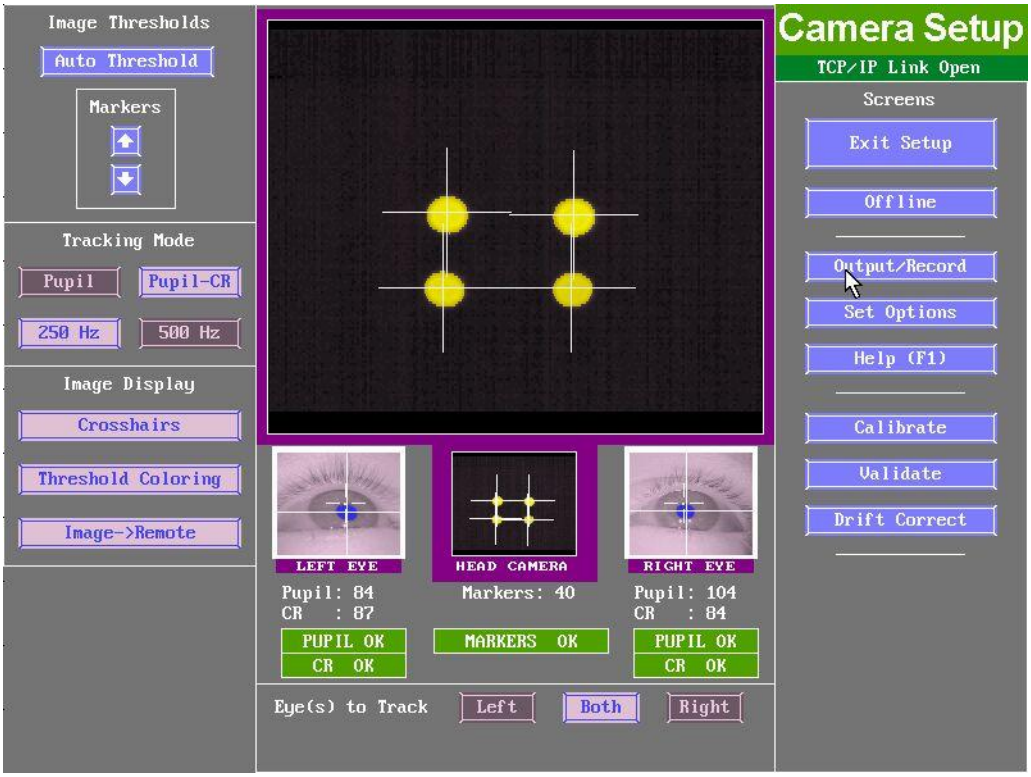



***Figure 3-15. Missing Scene Camera Buttons***

- If there is no problem with the above two steps, open the Scenecam.ini and/or final.ini to make sure both `'scene_camera_enabled'` and `'scene_camera_gazemap'` are set to "ON" or "YES".

### *3.7.3 Seeing a Black Screen*

If you only see a black screen in the video window (See Figure 3-16), please check the scene camera system setup again:

- Has the cap of the scene camera been removed?
- Have you plugged in the right power adapter of the scene camera?
- Have you connected the video cable from the scene camera to the "V-IN" of the overlay box?
- Have you plugged in the right power adapter of the green AVT Overlay Box? Is it powered on (not in the "standby" mode)?
- Check the follow connections and settings on the AVT Overlay Box:

    1) Does the type of scene camera video output cable match the setting of video source input in the overlay box (i.e., "S-IN" when S-video input is used and "V-IN" when composite video input is used)?

2) Is the Overlay Box set at “Overlay” mode?

3) Is there any loose connection among the connectors? Try to disconnect the cables and then re-connect them.

4) If you are using ADVC-100 or 110 converter, the blue light indicator on the front will be set at “Digital In” mode by default. Press the silver input select button to switch video input mode to “Analog In”.

- If you are using ADVC-55 DV converter, do you see the green light on? The converter has difficulty in detecting the video source if the red light is on. Check for the possibility of having loose connections.

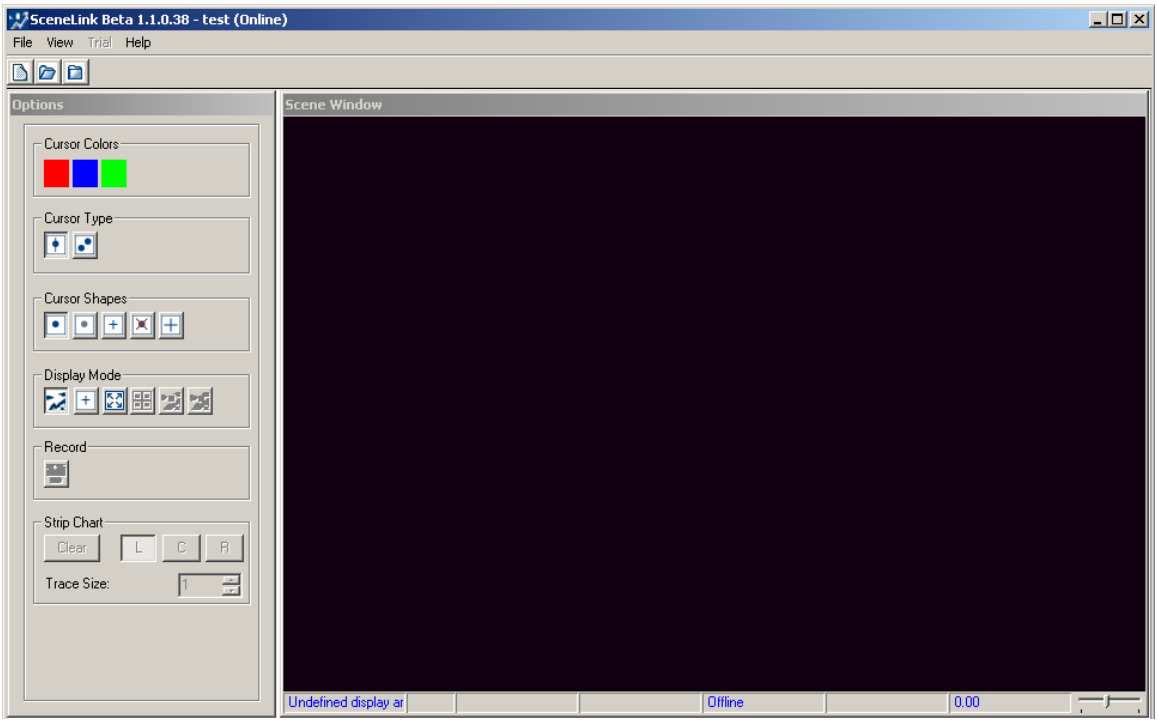



***Figure 3-16. Blank Screen in the Video Window***

# 4. Performing Recording with the SceneLink Application

In addition to the usual steps for EyeLink recordings, using the scene camera option requires extra steps to perform scene camera alignment and depth correction. In a recording session, the user should perform the experiment setup in the following order:

- Check the display area setting (i.e., calibrate the size of overlay graphics display and to align it with the scene camera video).
- Perform (or check) scene camera and head camera alignment
- Do eye/head cameras setup
- Calibration and validation
- Perform depth correction
- Recording and, if necessary, drift correction

The current chapter explains how to perform each of the above steps with the SceneLink application. The SceneLink application allows for greater flexibility in scene camera data recording and playback. With this application, the user has a real-time gaze overlay preview during recording and can change the gaze cursor and shape on the fly. More importantly, this application allows for scene camera video saved as digital video (in .AVI file format) without any gaze overlay graphics. Overlay graphics are generated during data playback.

## *4.1 Modes of Operation*

**Recording eye movement data and scene camera video with the SceneLink application should be controlled from the display PC. Although recordings can be started and stopped from the host PC, doing this may cause difficulties in data playback later on.** To perform a recording with the SceneLink application, the user will have to go through several modes, in the order of display area checkup, camera setup and calibration, scene camera alignment, depth correction, output and recording. Each of the above modes is entered by clicking on the corresponding display mode button (see Figure 4-1).

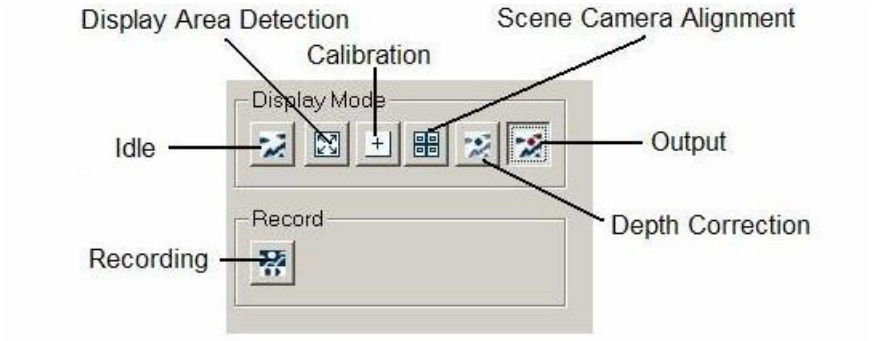


***Figure 4-1. Modes of Operation for SceneLink Recording***

## 4.2 Idle (Preview) Mode

The idle mode (), the default mode of the SceneLink application, displays the camera scene on the display computer. This mode is useful for checking the connection between the host and display PCs and the overlay settings (see section3.7 "Checking Connections and Settings"). **Important!** If you see any menu items of the EyeLink host PC screen shown in the video, please make sure Button 5 of the overlay remote control has been pressed to zoom in the host PC video output (see Figure 4-2).

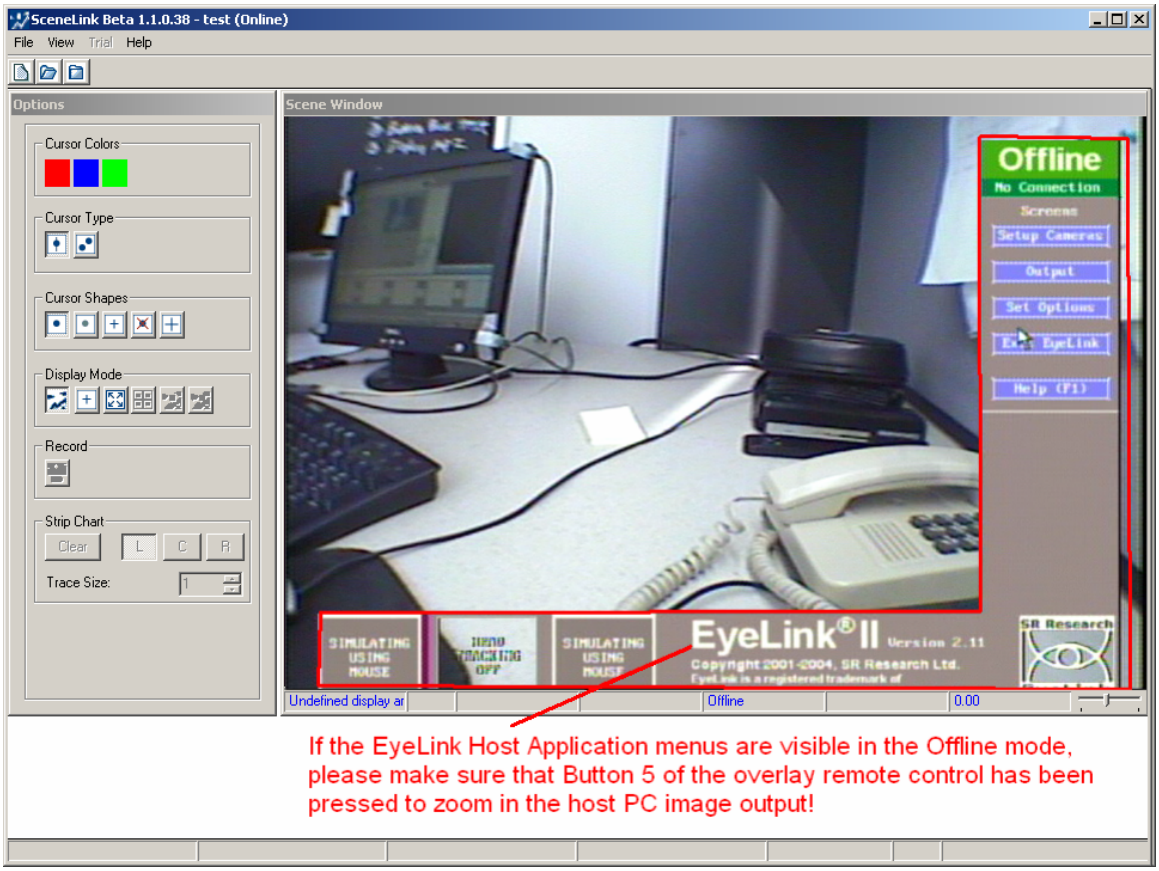



***Figure 4-2. Example of Unzoomed Host Screen Overlay***

## 4.3 Display Area Detection Mode

The display area detection mode () is used to calibrate the size of overlay graphics display and to align it with the scene camera video. When this mode is entered, some line drawings are added to the scene camera video and a "Video Alignment" dialog box is displayed (see Figure 4-3), followed by a "Detect

Display Area" dialog box. If you are using a Dell C- or D-series laptop as the host PC on a docking station, make sure you have computer signal sent to both the monitor and overlay box (As mentioned earlier, Dell D-series laptop users should have an extra computer monitor connected to the docking station). If you do not see a box consisting of a highly visible moving pattern ("crawling box") on the SceneLink video screen, you should press "Fn" + F8 (CRT/LCD) shortcut keys on the laptop keyboard.

In the Video Alignment screen, the user should first adjust the size of the overlay display, which is indicated by the crawling box. Note also the drawing of a square with arrows, located just inside the top-left or bottom-right corner of the crawling box. Click the "select" button (  ) on the dialog box to select the corner of adjustment. Use the four arrows buttons to adjust the size of the crawling box to maximum while keeping the outside edge of the moving pattern still fully visible. Click the "select" button to switch to adjusting the other corner. Press the "Next" button to continue.

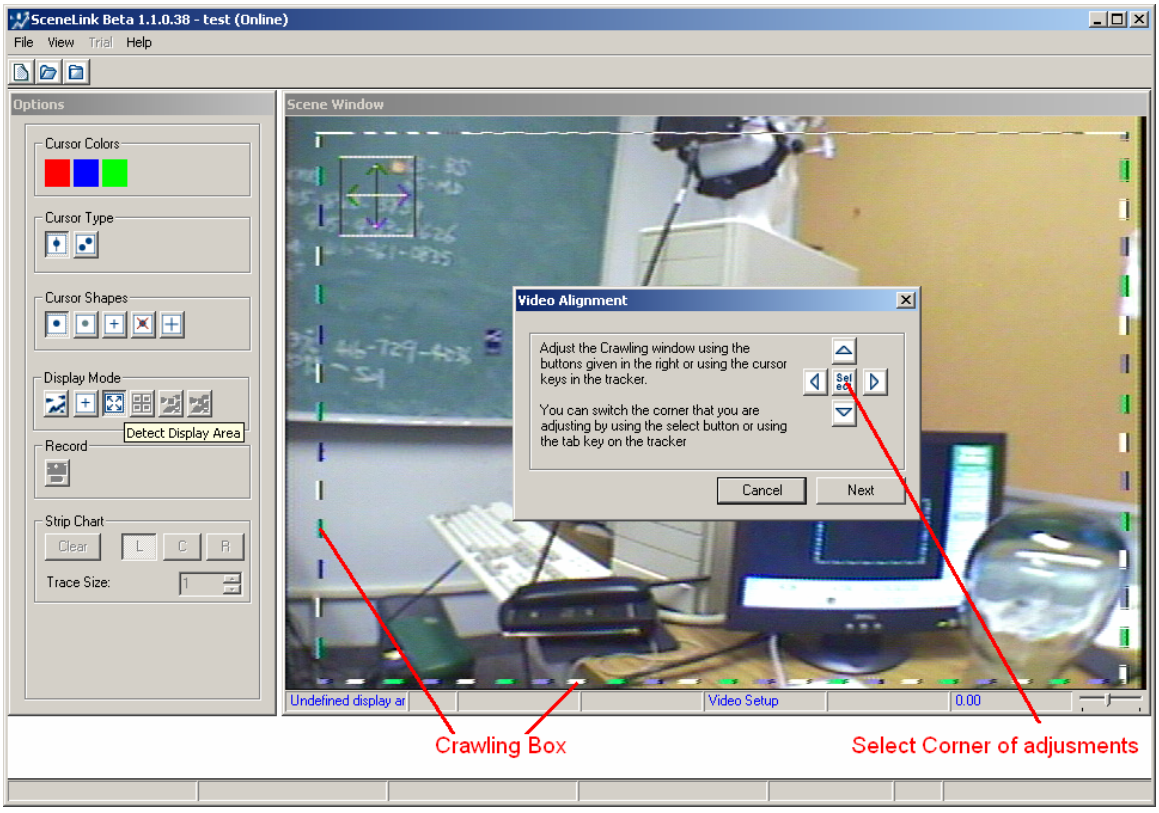



***Figure 4-3. Adjusting the Size of Overlay Display***

Following this, the overlay graphics and scene camera video can be aligned. A "Detect Display Area" dialog box will appear on the background of gray box with a white box in it (see Figure 4-4). If the gray box does not appear, please check the "Video Setup" screen of the host PC to make sure the "Video Ref Pattern"

button is enabled. In the "Detect Display Area" dialog box, press the "Detect" button to let the video card detect the display area (the gray box). If the detection is successful, two red/pink reference boxes are added onto the display and the detected area is reported in a message similar to "Detect OK. Display at 24 8 698 465" (see Figure 4-5). Press the "Reset" button to clear the current settings and redo display area detection or press the "Finish" button to exit this mode.

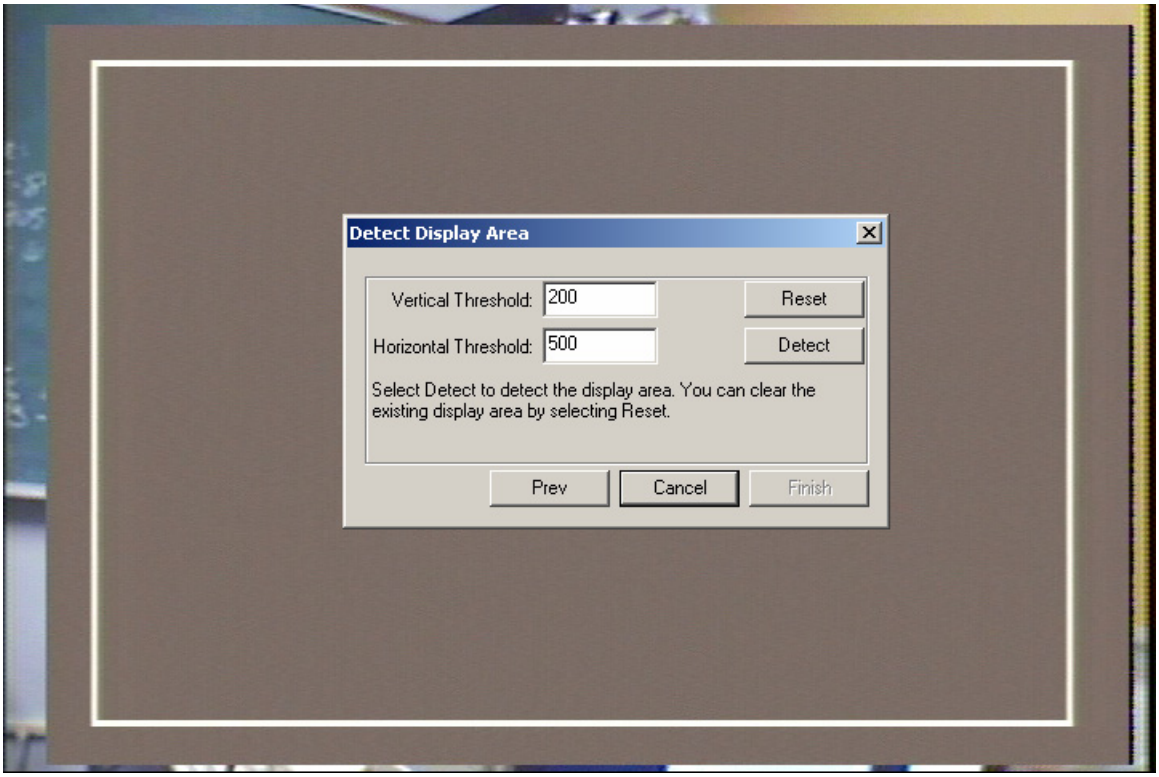



***Figure 4-4. Beginning Display Area Detection***

In the "Detect Display Area" dialog box, if the red reference boxes do not appear, the user may need to adjust the values of the "Vertical" and "Horizontal" brightness threshold downwards by 10%, and then click on the "Detect" button again. Repeat this step until the reference pattern appears on the screen. Please make sure the gray background is displayed all the time; otherwise, please check for the "Video Ref Pattern" button setting on the host PC. The default threshold settings work for most of recent video cards. If not, please first check whether you have zoomed in the host PC video output by pressing button 5 of the overlay box remote control (note the size of the gray box relative to the "Detect Display Area" dialog box). However, if the reference pattern is not displayed even when the vertical and horizontal thresholds are adjusted close to 0, please contact SR Research Ltd.

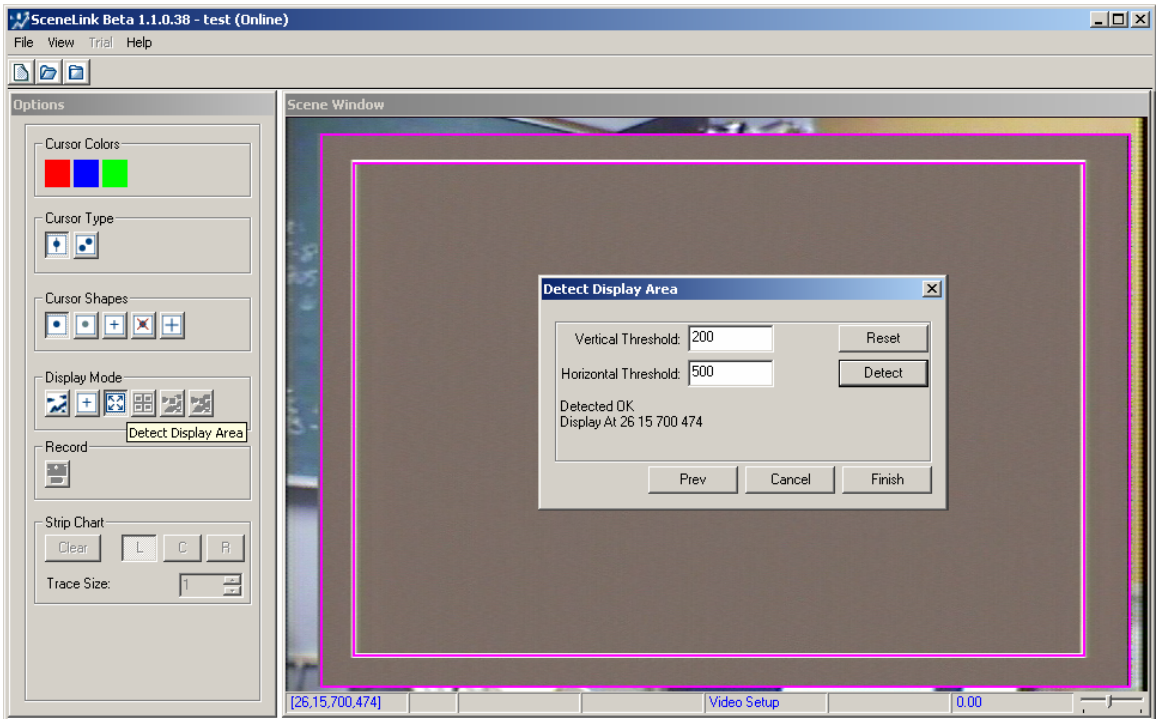



***Figure 4-5. Successful Display Area Detection***

The SceneLink application is now ready to use. Note that the calibration of overlay graphics display to scene camera video needs to be done only once, as long as the overlay and scene camera settings have not been changed. However, the user should enter this mode to verify this at the beginning of each recording session.

## *4.4 Scene Camera Alignment Mode*

The optical alignment between the scene camera and head camera must be done when the scene camera is used for the first time. By performing the alignment, the gaze accuracy on the overlay display at the calibrated depth is ensured. To perform the alignment:

- From the Camera Setup Screen of the host PC, press the "Set Options" button. In the following screen, make sure "Head Tracking" button is enabled. Press the ENTER key to return to the previous screen.
- On the Scene Camera Alignment screen of the host PC, first check for the scene camera lens selection. Make sure this setting (72° or 95° field of view) matches exactly with the actual type of lens mounted on the scene camera bracket. **Note:** A 95° lens has a diameter of 17.0 mm measured from the left end to right end (including the black edge); 13.5 mm measured from the inner ring (glass part only). A 72° lens has a

diameter of 13.5 mm measured from the left end to right end (including the black edge); 11.2 mm measured from the inner ring (glass part only).

- Click on the "Scene Camera Alignment Mode" button (  ) on the display PC or the "Alignment" button on the Camera Setup Screen of the host PC.
- Have a participant sit in front of the display PC monitor with IR markers properly positioned. Place the headband on the participant's head.
- If necessary, loosen the screws of the scene camera, angle the scene camera appropriately so that it sees as much of the scene of interest as possible if the participant looks at the target area/depth. Tighten the camera screws.
- Ask the participant to fixate at the center of the display PC monitor. Head movements may be required to ensure that there is only one marker in each quadrant of the overlay display (separated by colored lines) and that each marker is reasonably distant from other markers (see Figure 4-6). Avoid having the markers showing up too close to the corner of the overlay display as the optical lens distortion is less well compensated there.
- For each quadrant of the overlay display, place the display PC mouse cursor over the center of IR marker in the scene video. Click the left mouse button. This must be done carefully to achieve best accuracy.
- If working properly, the color boxes in the overlay display will move according to the participant's head movements. If head tracking is enabled, the boxes should be always on top of the center of the markers

The scene camera alignment should be done only if the relative position between the scene camera and the head camera is changed or if the lastrun.ini file in the eyelink2\exe directory is modified. However, it is a good practice to check the alignment at the beginning of each recording session.

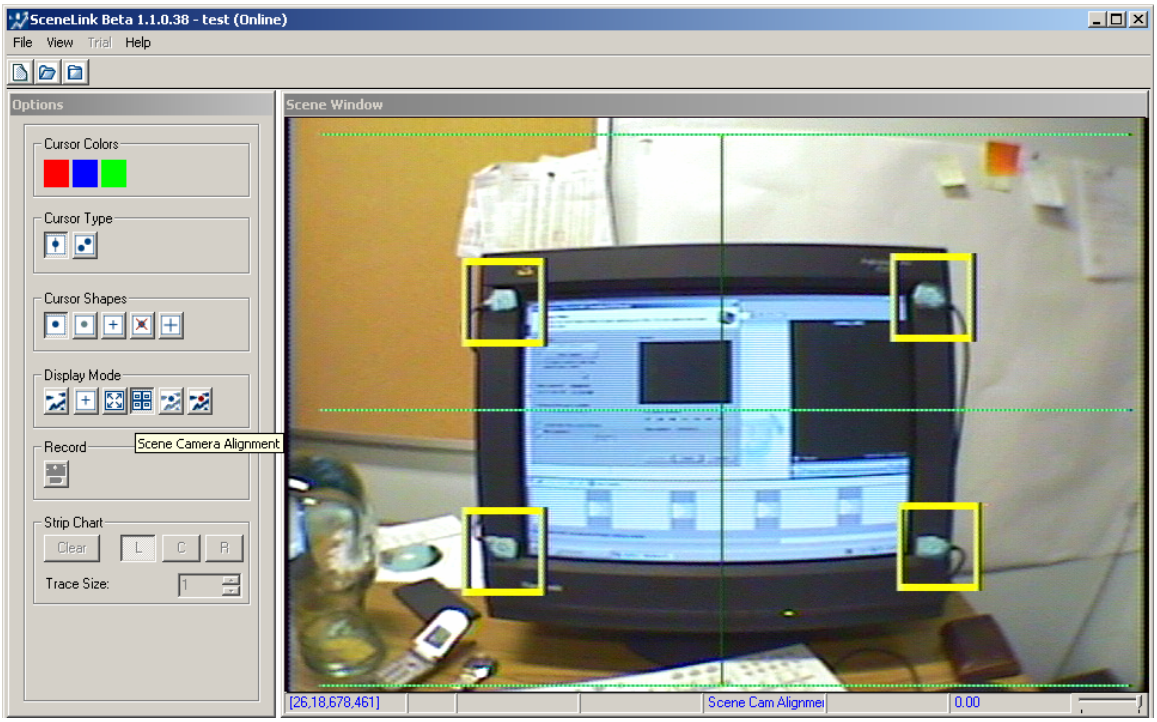



***Figure 4-6: Optical Alignment between the Scene Camera and Head Camera.***

## *4.5 Calibration Mode*

For best scene camera performance, recordings must be done in the corneal reflection mode with both eyes tracked. The corneal reflection mode is used for the headband slippage protection whereas the binocular tracking is used for parallax fixup at the non-calibrated depths. In addition, the calibrated region should be where most of the recording activities happen. If you are performing a binocular recording, participants should be calibrated in a standard vertical display to minimize nonlinearity in the calibration mapping. The depth correction can then be performed on several depth levels in the target space (e.g., by fixating at several points on a desk). If a recording must be done in a monocular mode for some reason, try to perform the calibration and validation as close to the target plane as possible. This is because depth correction is not possible in a monocular recording and therefore the user must be aware of the ramifications of doing this (i.e., gaze inaccuracy at uncalibrated planes).

Click on the calibration mode button (  ) on the display PC to set up a participant in a binocular tracking mode with Corneal Reflection on. Following the camera setup, perform a calibration by typing 'C' on either the host or display PC keyboard. Note that several types of calibration algorithms have been provided by SR Research Ltd. If a large calibration region is involved in an experiment, the "HV13" calibration type (selected from the "Set Options" screen)

should be used for best calibration accuracy. By default, a nine-point calibration type ("HV9") is used for a calibration in which the participant's eyes are at a distance from the monitor of about twice the width of the display area of the Display monitor. If the calibration result is good, proceed with validation by clicking on the "validation" button or by typing 'V' and press the space bar to initiate the process. After accepting the validation results, the user should press the "ESC" key on the display keyboard to exit calibration mode. (Do not use "Alt" + "Tab" key combinations as you are still running the SceneLink application!!!)

### *4.5.1 Calibration Colors*

The colors of the calibration target and background can be configured through preferences prior to starting a recording session. Click "View -> Preferences" from the application menu bar. Select the "Advanced" tab and set the intended background and foreground/target colors.

### *4.5.2 Physical Coordinates Settings*

A good calibration requires the users to have a proper physical setup for the experiment. By default, the tracker will read in the "marker_phys_coords" and "screen_phys_coords" values in the physical.ini at the current EyeLink host directory (by default "c:\eyelink2\exe"). Users can also update the physical setup by clicking "View -> Physical Coordinate Settings" and check the "Overwrite Physical.ini settings" option. Clicking on the "Read From Host" button will load in the current values set in the physical.ini file.

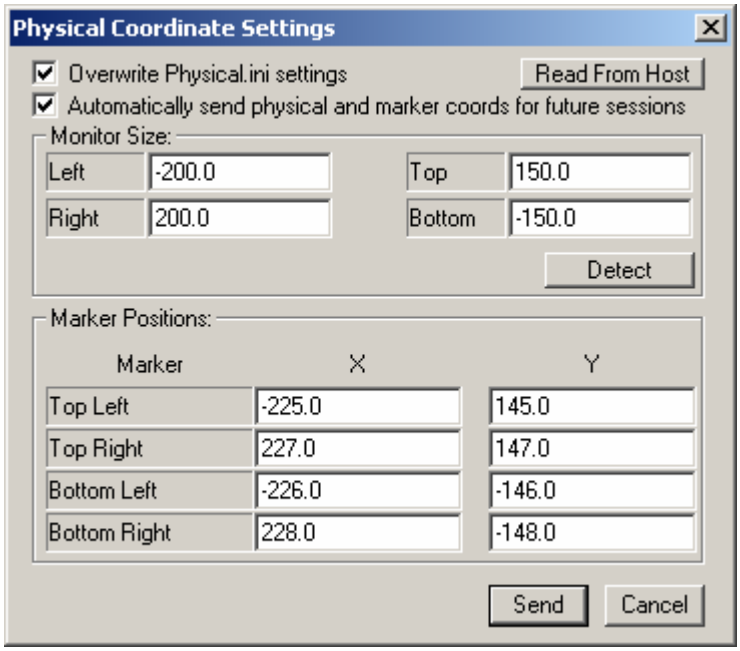



***Figure 4-7: Updating Physical Coordinate Settings***

The “Monitor Size” values measure the distance of the visible part of the display screen edges relative to the center of the screen in millimeters (corresponding to “screen_phys_coords” command). Enter a negative value for the left edge and bottom edge distances. Click “Detect” button will let the software automatically detect the size of the monitor. The “Marker Positions” values are determined by the physical position of LED markers (corresponding to “marker_phys_coords” command). The X/Y values in the table refer to the horizontal and vertical distances in millimeters relative to the center of the screen. Enter a negative value if the marker is to the left of the center of screen or below the center of the screen.

To apply changes in the physical coordinate settings, press the “Send” button. The modified settings will be used for the current session. Always redo a calibration if the physical setup values are updated. Enable the “Automatically send physical and marker cords for future sessions” option if the modified settings should persist over future sessions.

### *4.6 Depth Correction Mode*

The depth correction mode ( ) is used to correct for depth parallax in the scene camera overlay and **must be performed prior to each recording session.** In a scene camera recording, if “cyclopean gaze cursor” option is enabled, the “ball” of the cursor is positioned at the average X and Y gaze position of the two eyes. When a participant is fixating on a target at an uncalibrated plane, the ball of the cursor may be drawn at a different position from where the participant intends to look at. This error is caused by the difference in the viewing angles between the scene camera and the eyes (i.e., parallax error). Therefore, a depth correction following calibration is critical for any experiment involving viewing targets at different viewing depths.

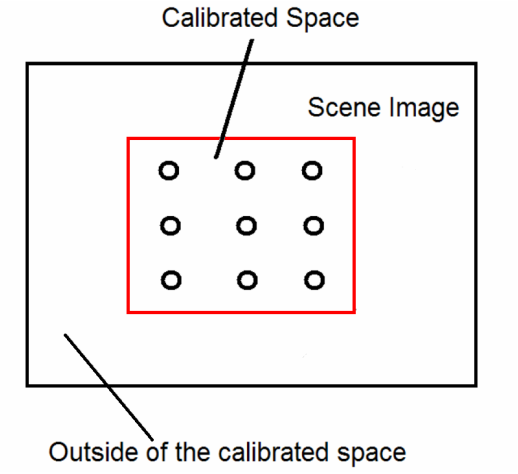


***Figure 4-8. Calibrated Space Viewed in the Overlay Display***

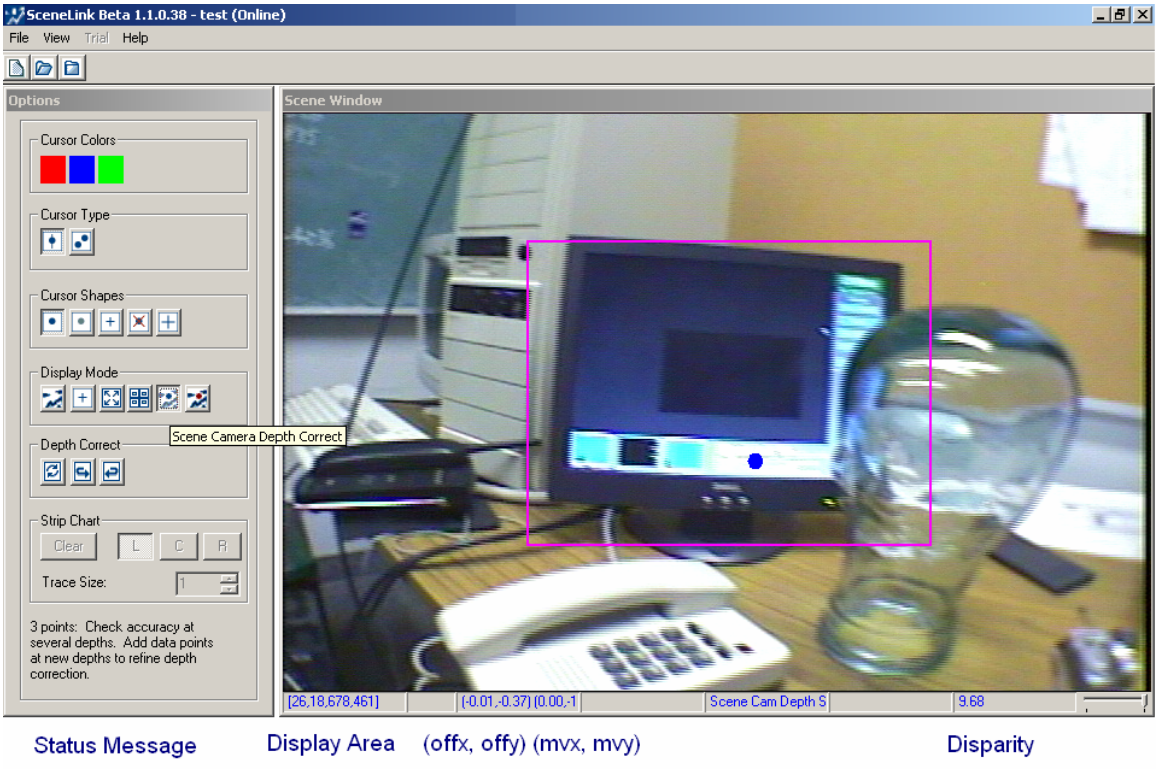



***Figure 4-9. Scene Camera Depth Correction***

Follow the following steps to correct for parallax error:

- Click on the depth correction mode ( ) button on the scene camera application. If a calibration has been successfully done, a red box will be displayed on the video screen representing the calibrated space (see Figure 4-8). The drawing of this box can be toggled on/off by clicking on the "Hide Calibrated Area" box.

- The first data point of depth correction, behaving like a drift correction point, performs a global offset adjustment and changes the value of "offx" and "offy" in the fitting function. The subsequent data points change the correction slope "mvy" (and "mvx" as well if '`scenecam_depthfix_xy`' is enabled). Therefore, the first data point in the depth correction procedure should be placed as close to the calibrated plane as possible whereas the subsequent points could be chosen from very different depth levels within the calibration space to make the correction more precise. For a calibration that is done close to the participant, the second point of the depth correction should be placed at a point in the calibrated space that is distant from the participant, and vice versa. As a rule of thumb,

collecting 4-5 points across various depth planes should be sufficient for a good depth correction.

- Specify a fixation target at a particular depth within the calibrated space and ask the participant to fixate on the target precisely. While the participant is fixating on the target, move the display PC mouse, place the cursor over the fixation target and click the left mouse button **once only** (see Figure 4-8). One correction data point will be added with each mouse click.
- The depth correction will fail if no stable fixation data is available or the distance between the fixation target and the current gaze cursor position is too large. Pay attention to the status message printed below the depth correction buttons to make sure the data point is successfully added and that only one data point is added for each sampling.

Typically, the user will perform a scene camera depth correction after calibration and validation and then proceed with data acquisition. However, depth correction can be improved or redone if necessary by entering this mode again. When in the depth correction mode, several active or grayed buttons, grouped under "Depth Correct", are displayed in the left panel of the scene camera application.

- If the user wants to restart the depth correction anew, simply click the "Clear & Restart" button (  ). This will clear the previous depth correction data points as well as the offset and slope values. A new data collection process can be started and another set of offset/slope parameters be derived to correct for parallax error.
- The user may also keep the existing data points and improve upon the last fit by adding more data points. This is done by clicking on the "Improve Last Fit" button (  ). While collecting more data points, the user can click "Clear & Restart" button to remove all existing data points and to start the data collection afresh, or abandon the new data points and revert to the previous parameters by clicking on the "Revert" button (  ). Clicking the "Revert" button again will keep the previous data points as well as the more recent data points collected – this is indicated by the text messages displayed at the bottom of the tracker screen.

### *4.7 Output Mode*

The output mode (  ) is used to manually track and record eye movements. This mode must be entered before a trial recording can be performed.

### 4.8 Record Mode

Recording of eye movements and scene camera video starts when the record mode ( ) button is pressed. If the "Log Messages" option is enabled, an edit box will be displayed so that the user can insert a message to the EDF file at the beginning of each trial. The recording can be stopped by pressing this mode button again. For each entry of the recording mode, one scene camera .AVI file is created while only one eye movement data file is saved for the whole recording session. **For the integrity of eye movement and scene camera video data, the start and stop recording operations should be done on the display PC only.**

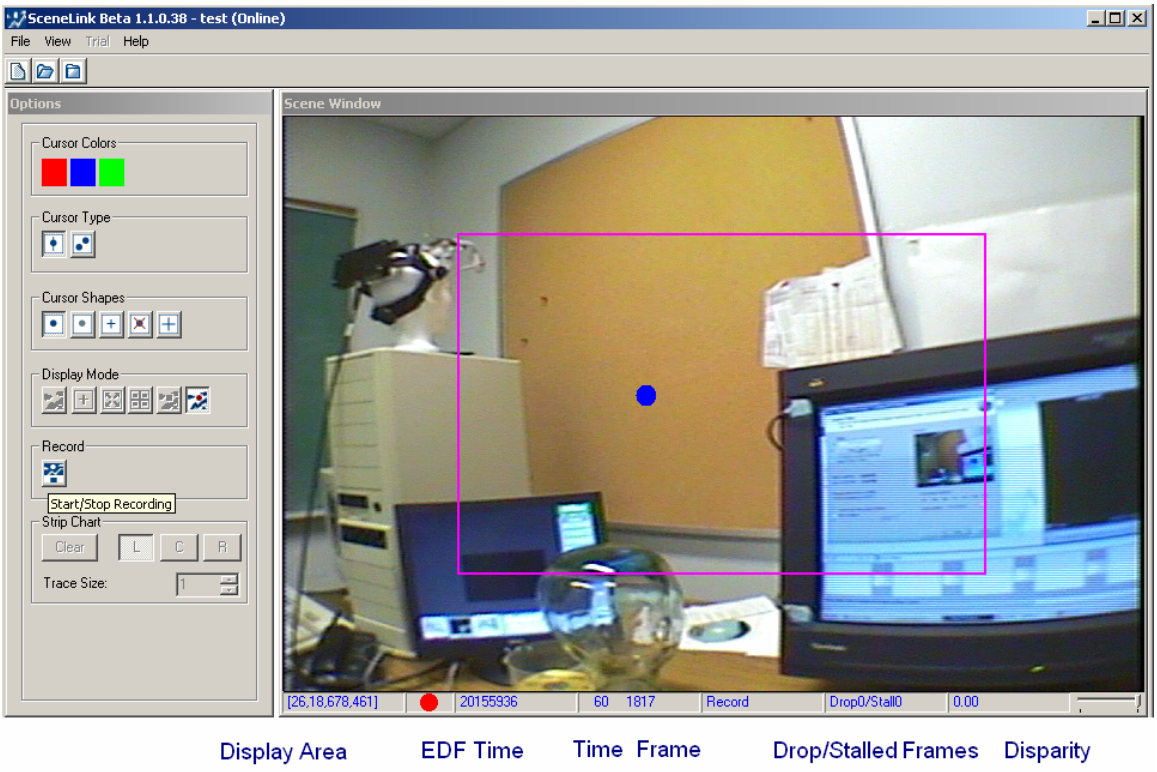



***Figure 4-10. Recording Screen***

In the recording display, the gaze cursor will be overlaid on the scene camera image, with the calibrated space marked as a box in the center of the recording display (see Figure 4-9). The status bar of the video window displays the following information during recording: display area, current EDF time of recording, time (in seconds) into recording and the current frame number of scene video, count of dropped or stalled video frames, and the current vergence information (disparity in the horizontal gaze position between the two eyes). Please note that a warning message "GAZE CURSORS DISABLED INI FILE OR COMMAND" will be printed out on the host screen if the recording is controlled by the SceneLink application – this is done by design.

### 4.8.1 Problem with Recording

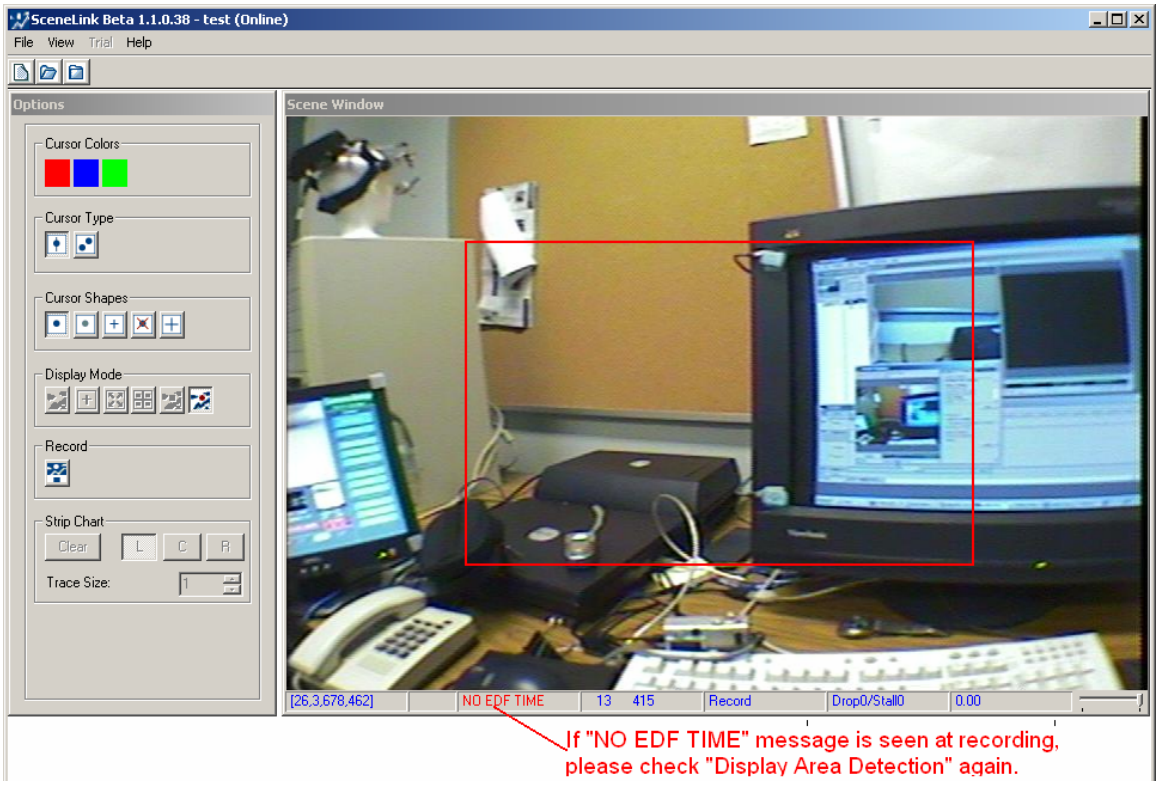



***Figure 4-11. Problem during Recording: "No EDF Time"***

As mentioned earlier, the gaze cursor will be drawn overlaid on top of the scene video when the recording starts. If the gaze cursor disappears when the record button is pressed and a red "NO EDF TIME" warning message is shown at the scene window, this means that the SceneLink application cannot detect the time code for synchronization between the eye data and scene video. To fix this issue:

1) Close the current experiment session. From the application menu bar, click "View -> Preferences" and select the "Advanced" tab of the preferences dialog box. Set the "Time Code Threshold" to a lower value (e.g., 430).

2) Redo the display area detection by making the crawling box smaller (especially the top edge, see section 4.3 "Display Area Detection Mode").

### 4.8.2 Synchronization with Third-Party Recording Devices

The SceneLink software allows users to send out synchronization signals to other third-party data acquisition devices through the parallel port of either the display computer or the EyeLink host computer. Please make sure you have installed the DriverLINX Port I/O Driver to support this capability. Before

starting a recording session, click "View -> Preferences". Select the "Advanced" tab. Check whether the base address of the parallel port is correctly set (LPT1 is typically assigned to the base address 0x378, while LPT2 is assigned to 0x278). Enable the "Start" (sending out a synchronization signal when SceneLink starts recording), "End" (sending out a signal when SceneLink stops recording), and "Clear" boxes (sending out a clearing signal 50 msec following the START or END signal, or BOTH). Now, specify the register (typically "DATA" register of the parallel port) where the signals should be sent and the intended TTL Values. Note that the base address and value fields expect a hexadecimal number (so the user should enter 0x378 instead of 378). The outgoing TTL signal is sent immediately after the eye tracker starts or stops recording and marked with a "SCENELINK_TTL [OUT] START_TTL" or "SCENELINK_TTL [OUT] END_TTL" message in the EDF file.

It is also possible to control the start and end of a SceneLink recording by external triggers received through the parallel port of the display computer. The address is typically set to the "STATUS" register of the parallel port. An incoming signal that matches the prespecified value will initiate a short lead in the video recording and then start the tracker recording. This input signal is marked with a "SCENELINK_TTL [IN] START_TTL" message in the EDF file. The end signal will immediately stop the eye tracker recording; this signal is marked with a "SCENELINK_TTL [IN] END_TTL" message in the data file. Please make sure both the start and end trigger signals last at least 50 ms for the SceneLink display PC to pick up reliably.

### *4.8.3 Performing Online Drift Correction*

During recording, if the user notices excessive drifts in the gaze cursor drawing, a runtime drift correction can be perform from either the display PC or from the host PC as shown below. **Important**: Please be aware that for a recording with scene camera option, the "Drift Correct" button in the Camera Setup screen behaves differently from a recording without using the scene camera. After performing a depth correction, clicking this button will bring up the Scenecam Depth Setup Screen and erase the original offset and slope parameters of the fitting function. So please avoid clicking on the "Drift Correct" button on the Camera Setup screen. Use one of the following two approaches instead.

#### *4.8.3.1 Online Drift Correction from the Display PC*

To perform an online drift correction from the SceneLink application, first specify a fixation target within the calibrated space at a particular depth (preferably at the calibration depth) and ask the participant to fixate on the target precisely. While the participant is fixating on the target, move the display PC mouse, place the cursor over the fixation target and click the right mouse button once. The drift correction may fail if there is no stable fixation data or if

there is a large error between the current fixation and the target item. By default, the maximum acceptable error value (set by the 'scenecam_dcorr_maxangle' command) is 20˚.

#### *4.8.3.2 Online Drift Correction from the Host PC*

Follow the steps below to perform an online drift correction from the EyeLink host PC.

- Click on the "Drift Corr" button on the Record screen of the host PC, which will flash periodically if enabled (see Figure 4-10).
- Move the mouse cursor (yellow circle) of the host PC over the intended drift correction target on the scene camera video, preferably a point on the depth plane where the participant was originally calibrated, and instruct the participant to fixate on the target precisely. Press the left mouse button only once when the participant fixates stably.
- If the data quality is not improved following the drift correction, the experimenter should check the camera setup and redo calibration, validation, and depth setup.


***Figure 4-12. Performing Online Drift Correction***

### *4.9 Recording Options*

Several configuration options, such as enabling overlay graphics, logging messages (see Figure 4-13), and configuring cursor color and shape, are available for SceneLink recording (see Figure 14). Enabling "Time Relative to Trial Start" option in the View menu will display the milliseconds elapsed since the start of the trial in the recording status bar instead of the absolute EDF time. The "Host Overlay" option, if checked, draws the overlay graphics from the host PC on top of the recorded scene camera video. This option is handy for users who want to record the video clips of the scene with the gaze position overlaid and do not wish to use SceneLink application to do the analysis. The "Log Messages" edit box, if enabled, allows the user to send a message to the EDF file at the beginning of each recording trial. The "Calibrated area" box, if checked, will display the calibration area drawing.

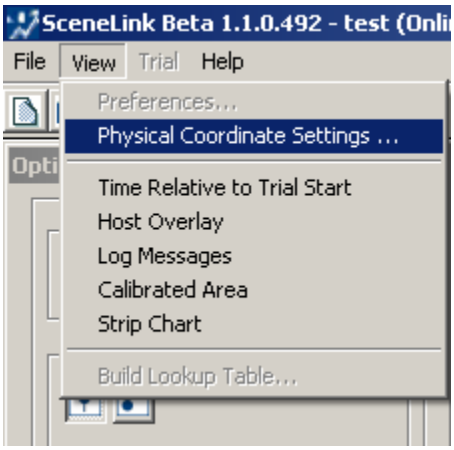



***Figure 4-13. Preference Settings***

Gaze cursors for use in the scene camera overlay have a selectable shape and color to improve visibility. In a binocular recording, if the cyclopean cursor ( ) button is enabled, the tracker will draw a single gaze cursor, representing the average of the two eyes; otherwise, the gaze positions will be drawn separately for each of the eyes ( ). Several colors can be selected for a cyclopean or each of the binocular gaze cursors. The color of the left, cyclopean, and right eye gaze cursor can be set by clicking on one of the three colored buttons. Gaze cursor may appear as a solid circle, a halo, a small cross hair, a full screen cross hair, or be disabled. Select the cursor appearance by clicking on the appropriate button in the "Cursor Shapes" section.

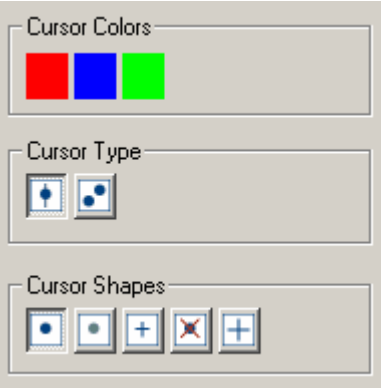



***Figure 4-14. Optional Settings for SC Recording***

## *4.10 Strip Chart*

The SceneLink strip chart plots the X and Y gaze position as a function of the current tracker time (in seconds) in a separate window (see Figure 4-15). This window only appears when in the output / record modes and in the playback mode of the SceneLink application. To show strip chart window, make sure the "View -> Strip chart" option on the application menu is checked.

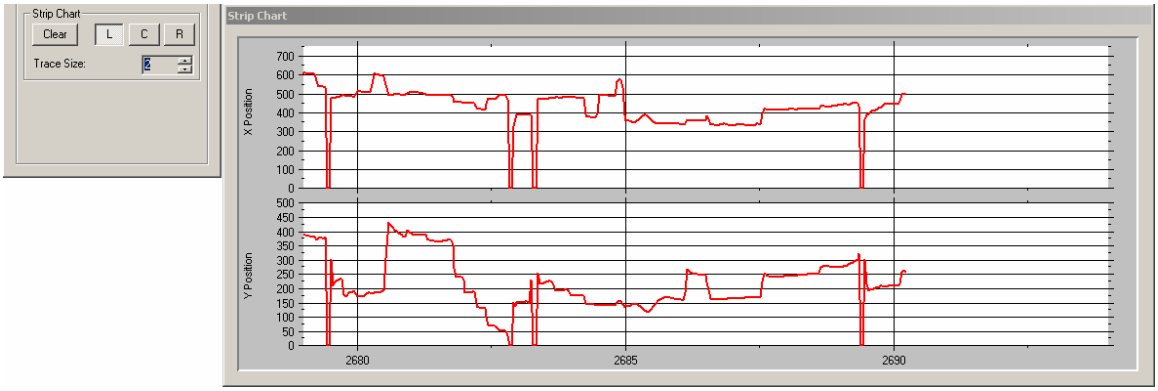



***Figure 4-15. SceneLink Strip Chart Window***

Several aspects of the strip chart display can be modified. User can choose to display the left-eye (L) and/or right-eye (R) position traces, or the cyclopean (C) gaze position traces. The thickness of position traces can also be adjusted. See "View -> Preferences" for more options on the strip chart (Section 3.6 "Configuring SceneLink Options").

## *4.11 Closing Recording Session*

A recording session can be closed by clicking "File → Close". This will close all of the EyeLink and scene camera recordings. The EDF file will also be

transferred from the host PC to the directory where the videos are stored. Please note that pressing this menu will give the following error if trial recording is still in progress (see Figure 4-12). Press the "Record" button to stop recording before the session can be closed.

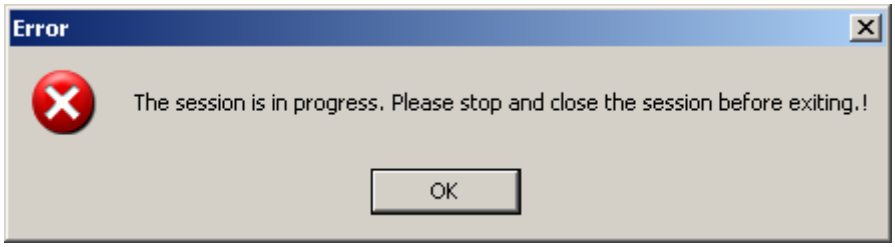



***Figure 4-16. Error in Closing a Recording Session***

## *4.12 Exiting the SceneLink Application*

Before exiting the SceneLink software, please make sure you have stopped any ongoing recording and clicked "File → Close" to close the current recording session. Click "File → Exit" or the close button on the top-right corner to close the SceneLink application.

# 5. Data Playback with SceneLink Application

The SceneLink application can also be used to play back a scene camera recording. During playback, gaze cursor positioning is generated from merging EyeLink data file with scene camera video files and is synchronized with the aid of binary millisecond eye data time code written to every scene camera field. This synchronization is better than one eye data sample (4 msec). During playback, the user can also dynamically change cursor type and control playback speed.

## *5.1 Opening a Playback Session*

To start eye data playback, click on "File → Open Playback Session" from the SceneLink application menu. (Recent sessions SceneLink recording sessions are listed in the "File -> Recent Sessions" menu.) This will prompt for an EDF file name. Go to the directory where the EDF files are stored and select the target file. Currently it is assumed that the EDF file name matches the .avi file name and that these files are stored on the same directory.

To run a synchronized playback of eye movement data over the scene video, a file containing a lookup table between the scene camera frame number and EDF time should be created. To do this, click "View -> Build Lookup Table" from the application menubar. In the following "avi2ett" dialog box, set the "Session" field to the EDF file (with path information). The user can choose to process all trials by checking "Create lookup table for all trials" checkbox or to select some of the trials in the list to process those selected ones only.

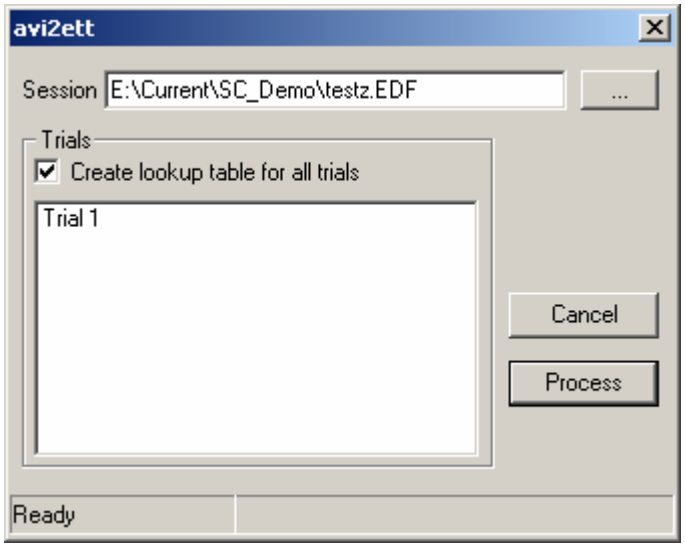



***Figure 5-1. Creating Lookup Table for a Recording***

Note that this should be done before running the playback session. A warning dialog (see Figure 5-2) will be displayed if the files containing look up table are missing from the directory. If this warning is given, press "Yes" button (recommended) to close the current playback session so that the look up table can be created. If you however wish to ignore this warning and continue the playback session, press "No" button.

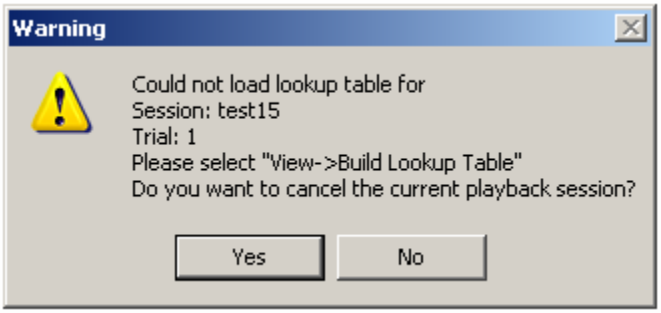



***Figure 5-2. Error in Finding Fame-to-Time Lookup Table***

## *5.2 Playing back a Recording Session*

If the EyeLink data file and corresponding scene camera video file(s) are loaded without any problem, the beginning of the first trial is displayed in the video window. The following buttons can be used to control the playback behaviors for each trial.

| | |
|---|---|
|  | Play Speed Control: Adjusts the speed of playback. Normal playback speed if the control is set in the middle, faster playback speed if moved to the right end and slower speed if moved to the left end. The five marked tick positions correspond to 10%, 50%, 100%, 150%, and 200% of normal playback speed. |
|  | Rewinding Control: Stops playback and rewinds to the beginning of the file or trial. |
|  | Fast Backward Control: Steps back 5 frames of video. |
|  | Backward Control: Steps back 1 frame of video |
|  | Fast Forward Control: Steps forward 5 frames of video. |
|  | Forward Control: Steps forward 1 frame of video. |
|  | Play Control: Starts playing back the trial data. |

| | |
|---|---|
|  | Pause Control: Pauses the playback. |
|  | Seek Control: Jumps to an intended position in a trial recording. |

***Table 1. Playback Trial Control***

The status bar of the video window displays the following information during playback: display area, EDF time of the video frame, current trial index, frame number of scene video in the trial, position of the mouse cursor in the video coordinate, and the current vergence information (disparity in the horizontal gaze position between the two eyes). If the corresponding .ETT file, which contains the frame-time lookup table, is not found for the trial, the conversion between EDF time and scene frame is not supported. Instead of the actual frame number of the video, an "Unknown Frame" message is displayed.

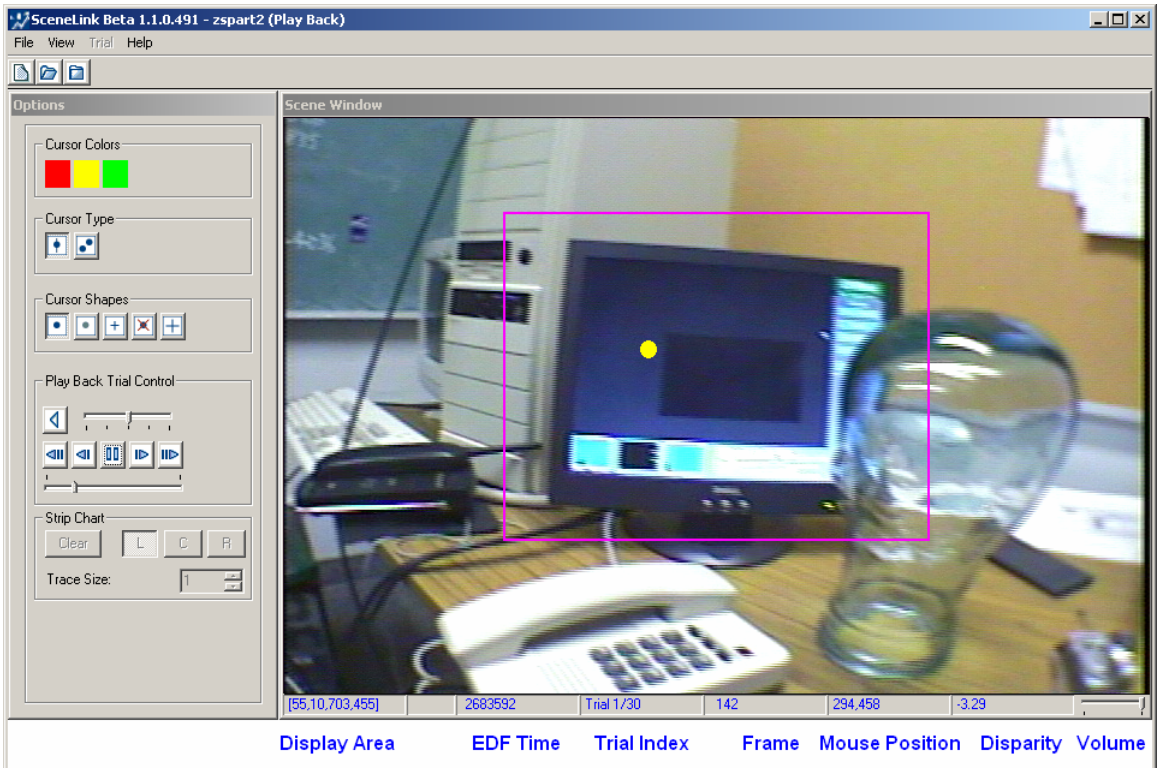



***Figure 5-3. Scene Camera Recording Playback***

As in data recording, the appearance of gaze cursor can be changed flexibly during playback (see section 4.10 recording options). If your recording session contains audio data, the audio stream will also be played during playback. To ensure the audio data is played correctly, make sure your audio device setting is correct (View -> Preferences -> "Audio Output"). In addition, you should

check whether the power of the speaker is turned on and the speaker volume is loud enough. The volume control at the bottom-right corner of the Scene Window should also be set to the right end.

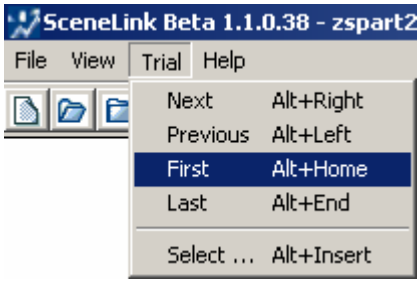



***Figure 5-4. Trial Navigation Controls***

For a SceneLink recording containing multiple trials, navigation between trials can be done through the "Trial" menu (see Figure 5-4). User can jump to a particular trial by choosing "Trial -> Select …" option.

## *5.3 Saving a Recorded Trial*

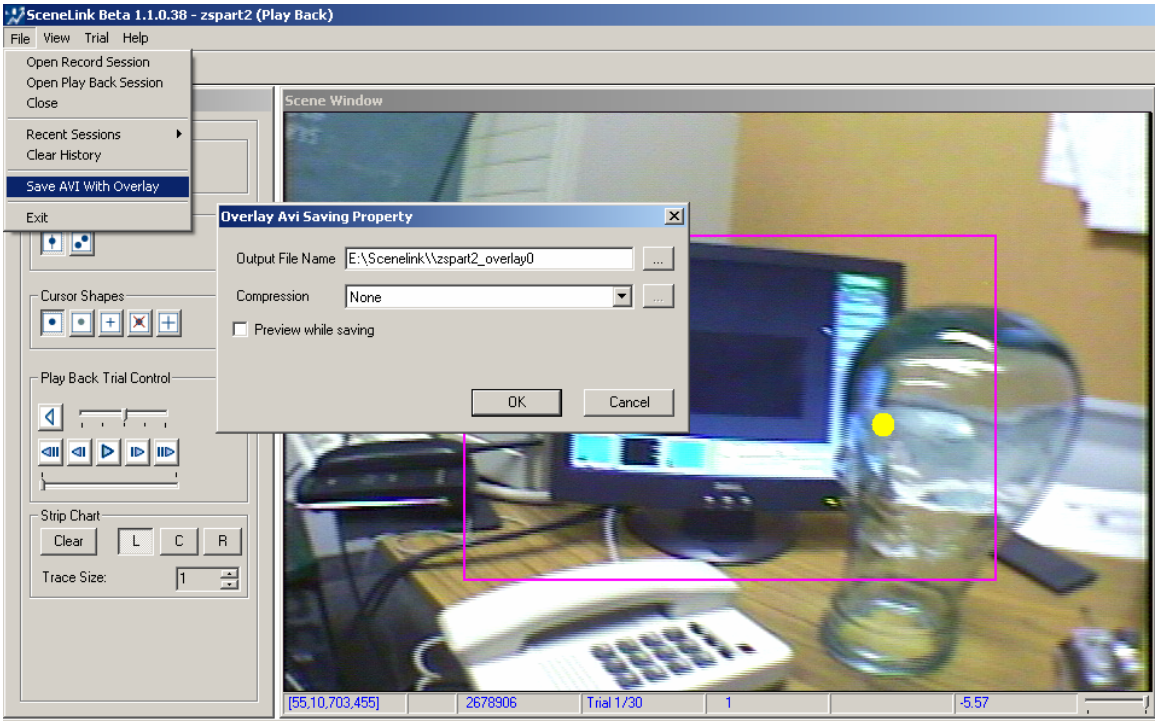



***Figure 5-5. Saving a Recording Trial as an AVI File***

To save an .avi file for the trial recording, user can select "File -> Save AVI with Overlay" (see Figure 5-5). The saved video clip contains both the scene video as well as the overlay graphics such as EDF time, current gaze position, and

calibrated region. To reduce the size of the saved overlay file, the user can choose a video codec for file saving. If "Preview while saving" option is checked, playback may pause briefly when saving the .avi file with the overlay graphics on; the saved AVI file, however, will play fine. **IMPORTANT!** When archiving a SceneLink experiment data, please make sure the original EDF file and video files created during data collection are saved.

### *5.4 Mapping Gaze Data to Digital Video Coordinates and Getting Frame Number in the ASC File*

The SceneLink application records eye-movement data in the resolution set in the display screen (e.g., 1024 * 768). The user can use EDF2ASC utility to convert the coordinate of eye data into the digital video coordinate (720 * 480). Once a lookup table is created for synchronized playback of eye movement data over the scene video (see section 5.1), the EDF2ASC converter can also be used to insert scene camera frame number messages in the ASC file. The following command line switches can be used with the EDF2ASC converter.

| | |
|---|---|
| -gazemap | outputs gaze data in avi coordinates (*-g* can also be used instead) |
| -insertframe | inserts frame number (*-i* can also be used instead) |
| -scenecam | same as using -gazemap -insertframe together |

The following modifications have been introduced to the Data Viewer so that scene camera video information can be extracted.

1) Two new options "Enable SceneLink Gaze Mapping" and "Generate SceneLink Frame Message" are added to the Data Loading preferences of Data Viewer. The former allows users to specify in data viewing session options to load EDF file with mapped gaze data to scene video coordinates. The latter allows the user to specify in data viewing session options to generate frame number messages when loading file. Please make sure you have made these changes before loading the intended EDF file.
2) The following variables are added to the Sample Report and Saccade/Fixation Report.

- Sample Report:

| | |
|---|---|
| VIDEO_FRAME_INDEX | Index of the video frame that was visible at the sample time. |
| VIDEO_NAME | Name of the video frame that was visible at the sample time. |

- Fixation and Saccade Reports:

| | |
|---|---|
| VIDEO_FRAME_INDEX_START | Index of the video frame that was visible at the start of the eye event. |
| VIDEO_FRAME_INDEX_END | Index of the video frame that was visible at the end of the eye event. |
| VIDEO_NAME_START | Name of the video frame that was visible at the start of the eye event. |
| VIDEO_NAME_END | Name of the video frame that was visible at the end of the eye event. |

### *5.5 Exiting the SceneLink Application*

Before exiting the application by clicking "File → Exit", please make sure you have closed all of the playback activities and clicked "File → Close" to close the current playback session.