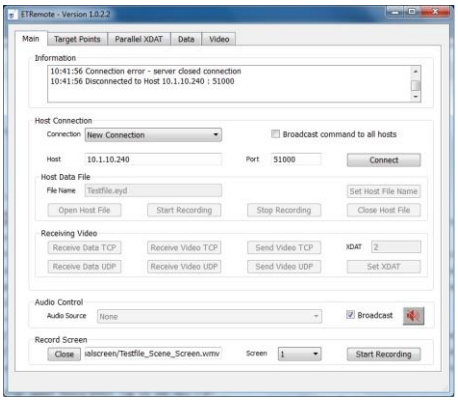
Eye Tracker Systems Manual

ETRemote for use with ETVision

MANUAL VERSION 1.5

October 2023



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1 General Description

An application called *ETRemote,* intended to run on an external Windows 10 or Windows 11 PC, is supplied with the *ETVision (*ETV) system. This manual version applies to *ETRemote* version 1.0.3.4 or higher. Contact Argus Science for download link.

ETRemote can connect to the *ETVision* via a local area network (LAN or wireless LAN) connection. It can receive and display data and video from the *ETVision* system, control data recording on *ETVision*, send XDAT values to *ETVision* for recording along with gaze data, record a screen video file on the external PC, or run a script to present a series of images or videos while marking ETVision data with the beginning and end of each presentation event.

The screen video, recorded as a wmv file with 30 Hz update rate and at the display resolution, shows whatever is displayed on the external PC screen, and can be set to start and end synchronously with the beginning and end of data files recorded by the *ETVision* PC. If the external PC is driving multiple screens, *ETRemote* can be set to record any one of these screens.

The network communication protocol used by *ETRemote* to interact with the *ETVision* system is described in a separate manual (NetworkCommWithETVision.pdf), and can be used by user created programs to interact with *ETVision* systems.

Some typical applications for the *ETRemote* application are described below.

Example 1
It may be desirable for people other than the equipment operator (perhaps the customer for an advertising or usability study) to monitor real time results from a separate location. *ETRemote* can be used, via a LAN, on a PC in the remote location, to display the same image seen on the ETV PC by the equipment operator.

Example 2
It may be desirable to start recording data simultaneously on two or more *ETVision* systems or to simultaneously add an event mark to data being recorded on multiple *ETVision* systems. *ETRemote* can connect to multiple *ETVision* systems and can broadcast commands to all of them to control those functions.

Example 3
If the optional *ET3Space* feature is being used, the system can record gaze position with respect to stationary surfaces in the environment. One of these surfaces can be a stimulus display monitor, driven by an external PC. If *ETRemote* is used to record the screen synchronously with *ET3Space* data, *ETAnalysis* can be used to superimpose gaze on the screen recording. Moving (or stationary) Areas of Interest can be defined on the screen recording, and gaze can be displayed and analyzed with respect to these areas. See the *ET3Space* manual for a description of the *ET3Space* feature (note that a head tracking system is required). See the *ETAnalysis* manual for a description data analysis using scene video files.

Example 4

If gaze data is collected as subjects view non-determinant content on a PC monitor (i.e., subject is browsing or other wise controlling the display), and if the data is to be analyzed using the optional *StimTrac* feature available with the *ETAnalysis* program, it is required that the external PC screen image be recorded on a video file that begins and ends at the same times as the data and video recorded by the *ETVision* system. If the external PC is running Windows 10 or Windows 11, this screen recording function can be provided by *ETRemote*. (See *ETAnalysis* manual for detailed description of *StimTrac*). If the primary surface of interest is a single stimulus display monitor, data analysis capabilities, with *StimTrac*, are similar to those for data collected with *ET3Space*. The difference is that an extra data processing step is needed, but an external head-tracking device is not required as it is for *ET3Space*.

Example 5

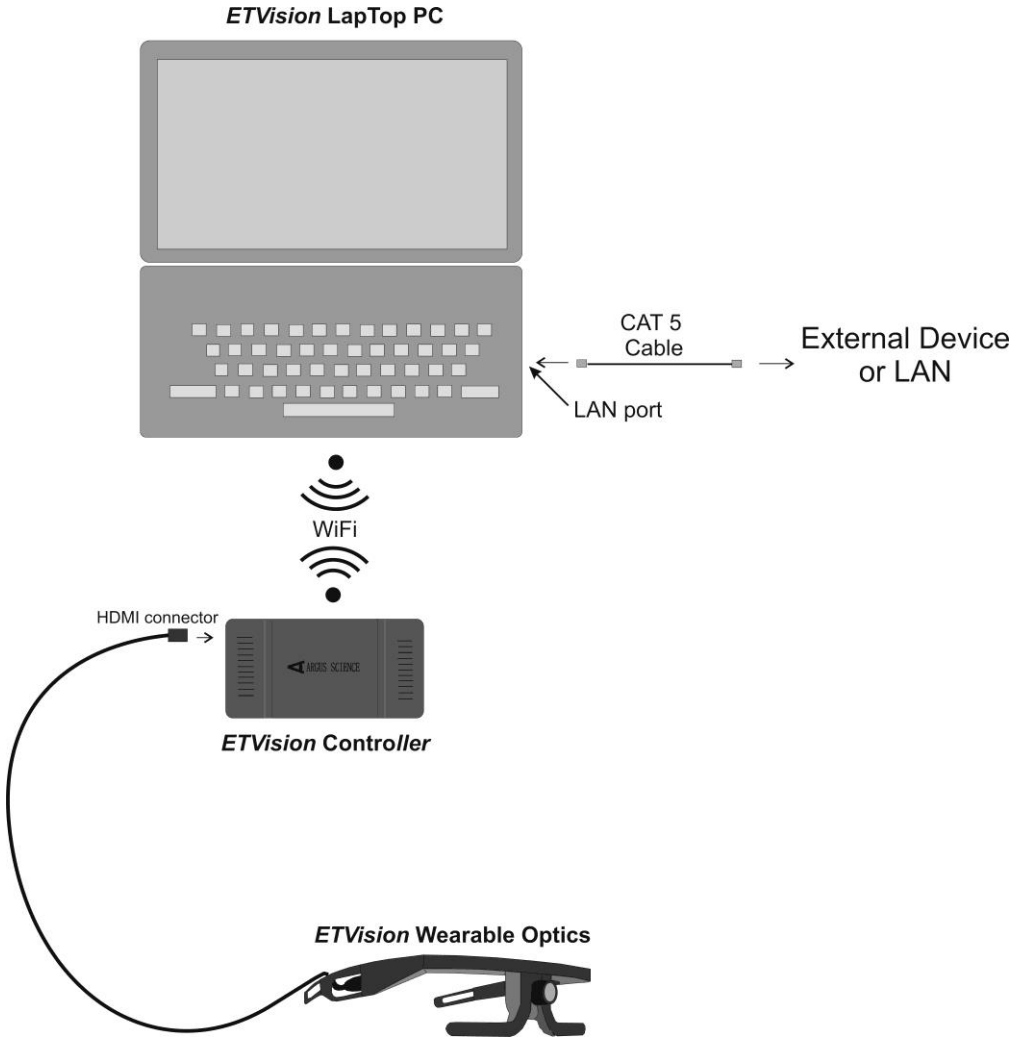
The *ETRemote* scripting feature can be used to display a series of images and/or videos to eye tracking subjects. A unique XDAT value will be sent to mark the beginning and end of each image display or video presentation on the data recorded by *ETVision*. If the *ETAnalysis*, *Stim Track* feature is used to process data, the XDAT marks can be used to parse the data into events that correspond to each displayed image or video, and Gaze can then be superimposed on directly onto each original image or video file.

Similarly, if gaze data was recorded with *ET3Space*, the *ET3Space* data corresponding to the PC monitor scene plane can be superimposed on each image or video file.

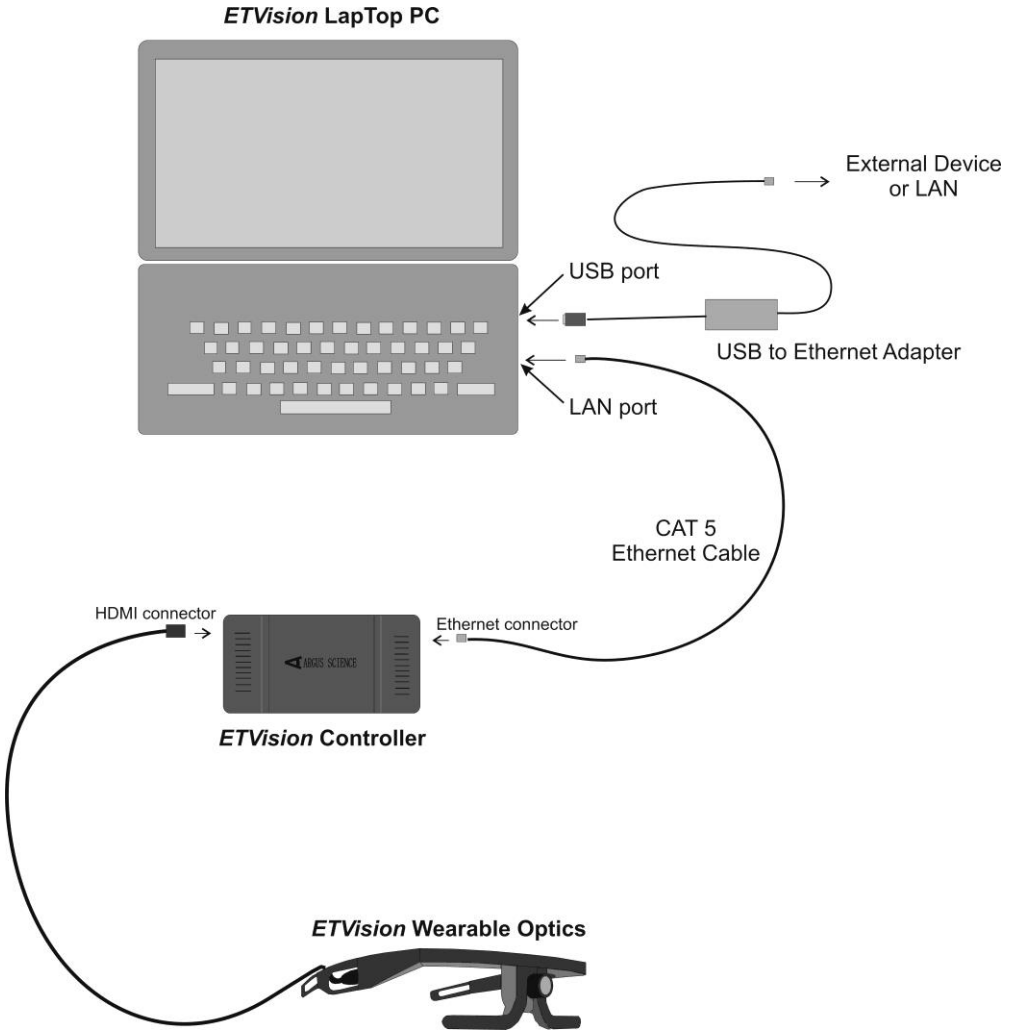
2 Installation and equipment configuration

Simply run the *ETRemote* installation program (iETRemote_x_x_x_x.exe, where "x.x.x.x" is the version number) on an external Win 10 or Win 11 PC. No activation is required for *ETRemote*. Consult Argus Science for the latest *ETRemote* install program.

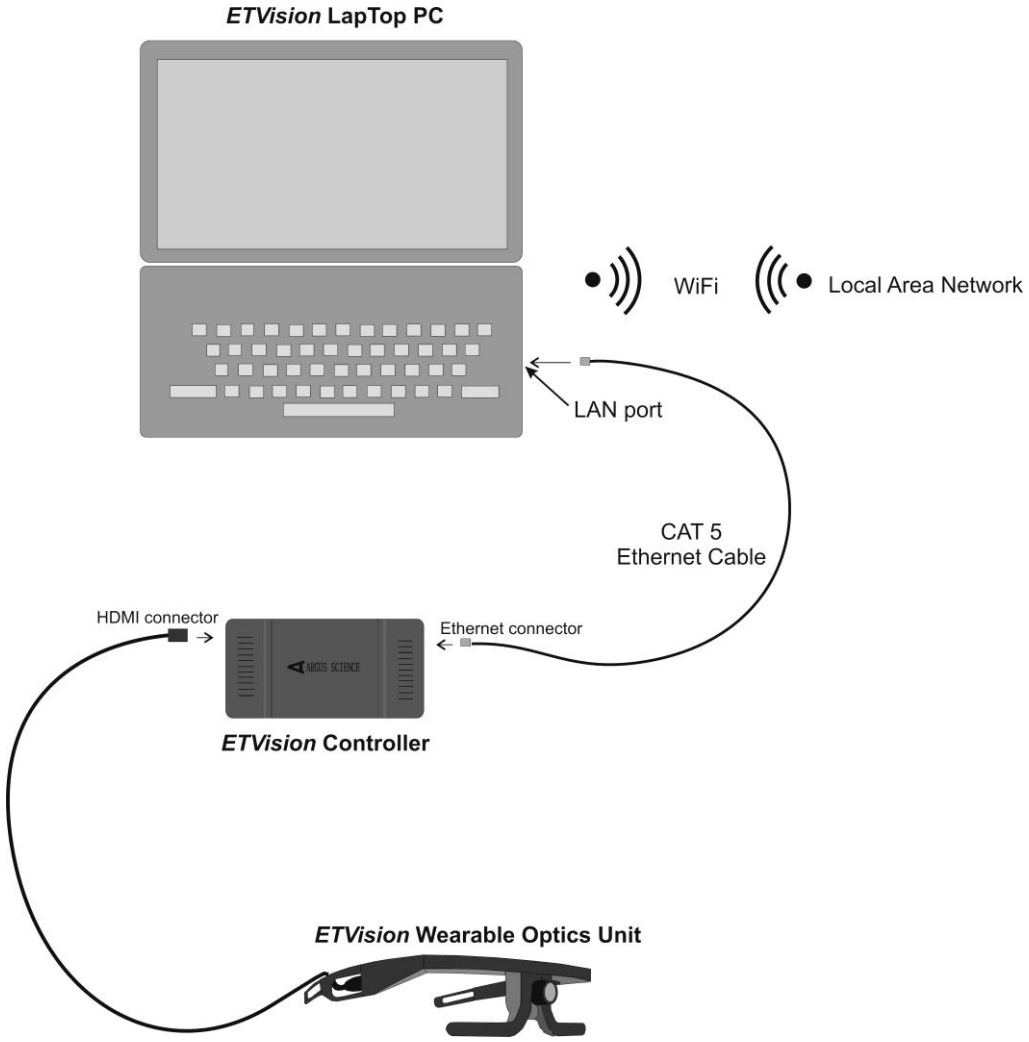
Configuration choices are illustrated by the following diagrams.



Configuration 1 – The ETV PC and Controller communicate via WiFi; a network cable connects ETV PC either directly to the network port on an external PC running *ETRemote*, or to a LAN that includes an external PC running *ETRemote*.



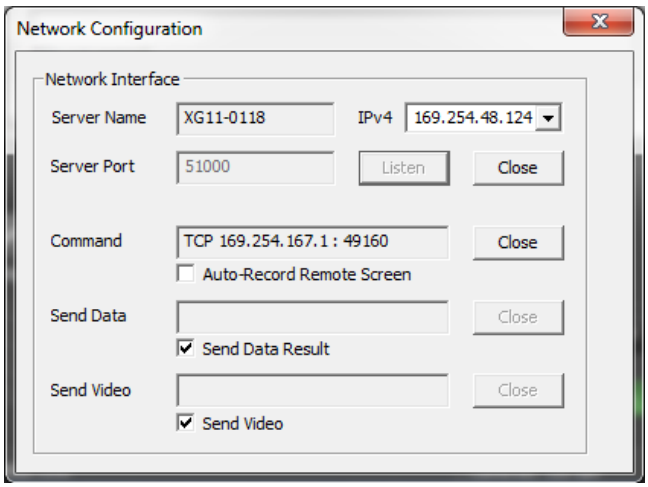
Configuration 2 – The ETV PC and Controller communicate via network cable, using the built in LAN port on the ETV PC; the ETV PC uses a USB to Network adapter to make a physical connection directly to the network port on an external PC running *ETRemote*, or to a LAN that includes an external PC running *ETRemote*.



Configuration 3 – The ETV PC and Controller communicate via network cable, using the built in LAN port on the ETV PC; the ETV PC uses a WiFi access point to connect to a LAN that includes an external PC running *ETRemote*.

Assuming the ETV PC is set for automatic IP address assignment (usual case as described in *ETVision* manual) ETVision will automatically detect whether there is an Ethernet cable connection between the optics and Controller. If there is no such connection it will use WiFi to communicate with the optics ("configuration 1" diagram); and if that connection is present it will use the cable connection as shown in the "configuration 2 diagram. For "configuration 3", the WiFi LAN access point must be selected from the list of WiFi connections, available on the Win 10 "system tray", on the *ETVision* PC.

On *ETVision*, open the Network Configuration dialog (open the *System Control Table* window, select the "Eye Data" tab, and click "Configuration under the "Real-Time Input/Output" heading).



Any IPv4 address available for network communication with an external device will be shown next to the IPv4 label. This address will be needed by the *ETRemote* application.

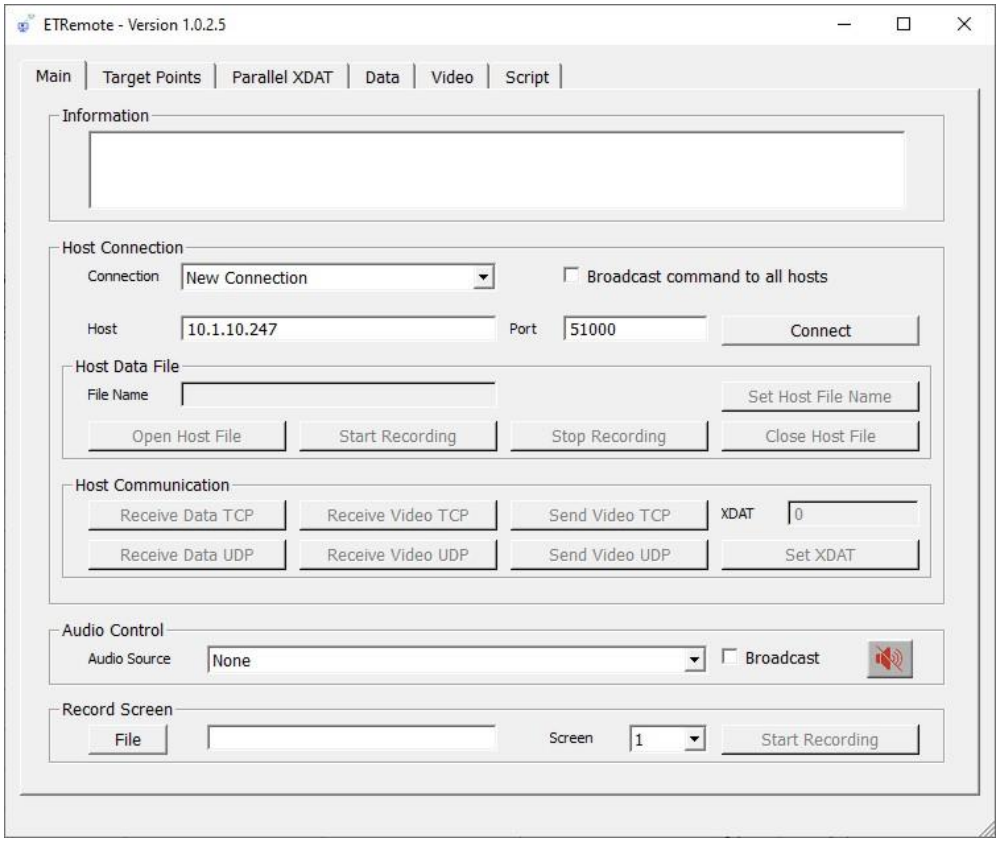
3 *ETRemote* Operation

The Parallel XDAT tab on the *ETRemote* window, and the Send Video buttons on the Main tab are for use with other eye tracker types, and have no function when using an *ETVision* (ETV) system. Other *ETRemote* functions are described below.

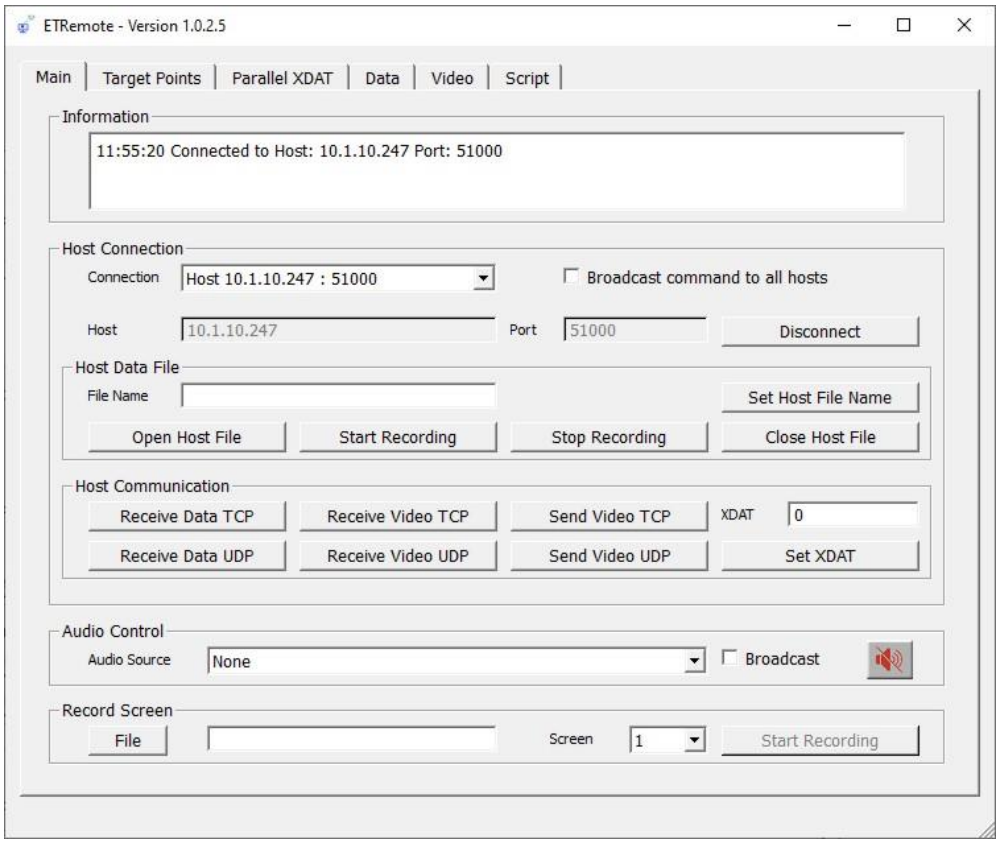
3.1 Connect *ETRemote* to *ETVision*

After preparing one of the Configurations described in the previous section, click the Listen button on the *ETVision* Network Configuration dialog. It will turn grey when clicked.

Run *ETRemote* on the external PC. The *ETRemote* window, *Main* tab, should appear as shown below. Under *Host Connection*, be sure "Connection" is set to "New Connection", as set *Host* to the IPv4 address as determined in the previous section (shown on the ETV Network Configuration dialog). If *ETRemote* is running on the ETV PC rather than an External PC, set IPv4 to "localhost". Set *Port* to 51000. If *ETRemote* will be used to record activity on a remote PC screen, and if the external PC is displaying different content on multiple screens, set *Screen*, under the *Record Screen* heading, to the number that specifies the screen to be recorded.

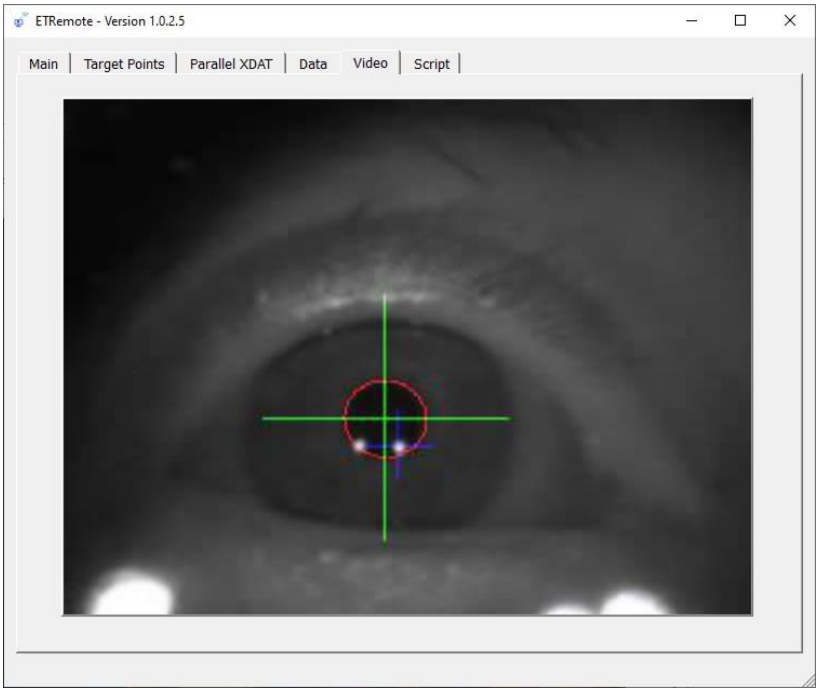


Click the "Connect" button. If a successful connection is made, the "Connect" button will change to "Disconnect", "Connection" will show the connected IP address and port number, and other buttons will become active.



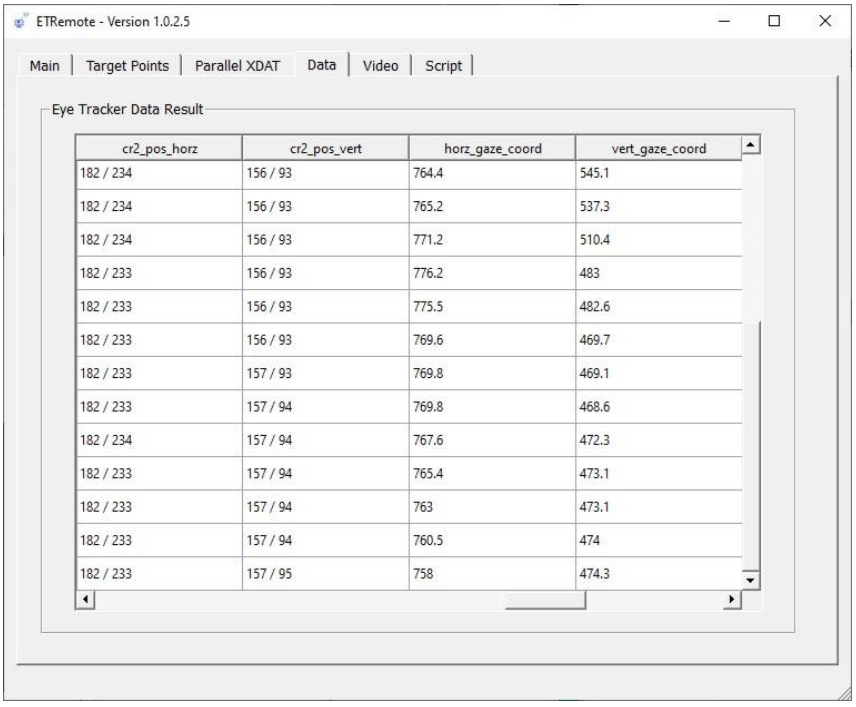
3.2 Display *ETVision* video on *ETRemote*

On the *ETVision* program, *Network Configuration* dialog, be sure that one of the *Send Video* boxes is checked ("Send Left Eye Video", "Send Right Eye Video, or "Send Scene Video"). On *ETRemote*, *Main* tab, click the *Receive Video TCP* or *Receive Video UDP* button, under *Host Communication.* Select the *Video* tab on the *ETRemote* window. The *ETRemote*, *Video* tab, on the external PC, should now display the same video image displayed on the ETV program window on the ETV PC. In the case of the sample image below, "Send Left Eye Video" was selected.



3.3 Display *ETVision* data on *ETRemote*

On the ETV program, *Network Configuration* dialog, be sure that *Send Data* is checked. On *ETRemote*, *Main* tab, under "Host Communication", click the "Receive Data TCP" or "Receive Data UDP" button. Labeled columns of scrolling data should appear on the *Data* tab of the *ETRemote* window.



cr2_pos_horz	cr2_pos_vert	horz_gaze_coord	vert_gaze_coord
182 / 234	156 / 93	764.4	545.1
182 / 234	156 / 93	765.2	537.3
182 / 234	156 / 93	771.2	510.4
182 / 233	156 / 93	776.2	483
182 / 233	156 / 93	775.5	482.6
182 / 233	156 / 93	769.6	469.7
182 / 233	157 / 93	769.8	469.1
182 / 233	157 / 94	769.8	468.6
182 / 234	157 / 94	767.6	472.3
182 / 233	157 / 94	765.4	473.1
182 / 233	157 / 94	763	473.1
182 / 233	157 / 94	760.5	474
182 / 233	157 / 95	758	474.3

3.4 Control File recording and set XDAT values on *ETVision*

ETVision always has a "profile" name specified. The default data and video file names are the profile name, with a date and time value appended. The date and time are the current date and time recognized by the *ETVision* PC when the file is opened.

To set file name from *ETRemote*, type a file name, or a path and file name in the "Host Data File" group box, and click the "Set Host File Name" button. If a path is not included, the new data and video files will be placed in the current file directory (the most recent specified in *ETVision*). CAUTION: if a path is specified, it must specify a directory, on the *ETVision* PC, for which the user has appropriate OS "permissions". If a file name is not set by *ETRemote*, then when a file is opened by ETRemote, it will be given the *ETVision* default name described in the previous paragraph.

Note that when specifying a file name it is usually not necessary to specify the extension. The file will automatically be given an "eyd" extension unless the *ET3Space* feature is enabled on *ETVision*, in which case it will be given an "ehd" extension.

Open *ETVision* data and video files from *ETRemote* by clicking "Open Host File". Video files with the same name will also be opened if the corresponding "Auto-record…" check boxes are checked on the *ETVision*, *System Control Table*, "Eye Data" tab.

Once data and video files are opened on *ETVision*, recording on *ETVision* can be started and stopped by clicking the "Start Recording" and "Stop Recording" button on *ETRemote*. Video files will be simultaneously started and stopped corresponding to any "Auto-record…" boxes checked on the *ETVision*, *System Control Table*, "Eye Data" tab.

Note that control can be mixed between *ETRemote* and the *ETVision* program. For example, it is possible to open new data file using the *ETvision* program, and then start recording from *ETRemote*; or to start recording from the *ETVision* program and stop recording from *ETRemote*; etc.

To set an XDAT (external data value) on *ETVision*, type the desired value in the *ETRemote* "XDAT" box, under "Host Communication", and click "Set XDAT". XDAT values must be integers between 0 and 65535.

3.5 Record the external PC display screen as a video file

If the external PC is controlling multiple screens, set the "Screen" number, at the bottom of the *ETRemote* Main dialog, to the number of the screen to be recorded. To manually start and stop recording the external PC screen as a wmv file, click the "File" button under "Record Screen", on the *ETRemote, Main* tab. Use the browser that appears to specify a path and name for the video file, and click "Save". Click the "Start Recording" button, under "Record Screen", to begin recording. When recording starts, the button function and label will change to "Stop Recording". Once recording has started the *ETRemote* application can be minimized, using the Win 10 or Win 11 minimize icon at the top right of the *ETRemote* window, so that it does not appear on the external PC display screen. Do not, however, click the "Close" icon, or *ETRemote* will have to be re-opened and connected as previously described.

If an audio source (usually a microphone connected to the PC running *ETRemote*) is specified, under "Audio Control" on the *ETRemote* "Main" tab, the remote screen recording will include an audio track with the specified source. If "Broadcast" is checked, under the "Audio Control" heading, the audio will also be sent to the *ETVision* PC.

To automatically start recording the external PC screen, in synchronization with *ETVision* data (eyd or csv) and video (wmv) files, check the box labeled "Auto-Record Remote Screen" on the *ETVision, Network Configuration* dialog. The *ETRemote* application, on the external PC, can be minimized so that it does not appear on the external PC display. Whenever *ETVision* begins recording a data file it will send a command to *ETRemote* to open a screen file and begin recording. A command to stop screen file recording and close the screen file will be sent to *ETRemote* by the *ETVision* whenever data recording stops.

The result of using the "Auto-Record Remote Screen" feature is that there will be a screen video file, recorded on the external PC, which has the same start and stop time as the corresponding *ETVision* data and video file.

If the stimulus is non-determinant content on a PC monitor (i.e., subject is browsing or other wise controlling the display) and if data analysis is to be done using the optional *StimTrac* feature on the Argus Science *ETAnalysis* program, it is essential that the "Auto-Record Remote Screen" feature be used when recording data. The stimulus screen session can be synchronously recorded by using *ETRemote*, as described above, or alternately by a user created program written to perform the same function. See the *ETAnalysis* manual for a description of the *StimTrac* feature.

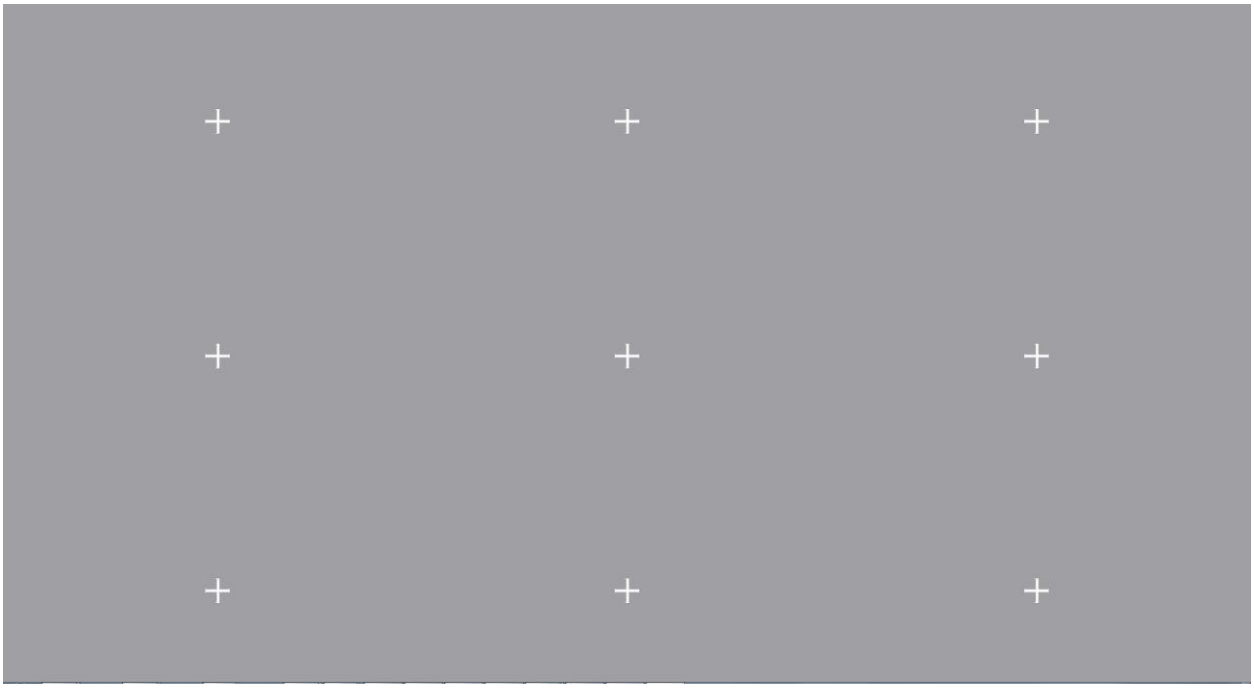
Similarly if *ET3Space* is used to record data and one of the environment surfaces is a PC monitor displaying non-determinant content, *ETRemote* "Auto-Record Remote Screen" feature can be used record screen content synchronously with *ET3Space* data.

Alternately, if the stimulus on a PC screen is pre-determined (i.e., a series of still images or one or more video presentations that are not controlled by the subject), it is better to use the scripting feature described in section 3.8 to present the material and send marks to the ETVision data to mark the beginning and end of each image or video.

3.6 Display Target Points

ETRemote can display a default target point pattern on the external PC running *ETRemote*. Note that this is not usually needed for *ETVision*, which is usually calibrated with a simpler Auto Calibration feature. However, if desired, this target pattern can be used for a multi point *ETVision* subject calibration (see *ETVision* manual for subject calibration instructions).

The background color and point displays can be modified in *ETRemote*, but the default positions of the points cannot be modified. There is no interaction between this display and the *ETVision* system, and no functional difference between this display and any other calibration targets that may be displayed in different ways.



If the calibration target points are to be displayed by a PC with multiple screens, first be sure that "Screen", under the "Record Screen" heading, is set to the proper screen number. To display the *ETRemote* calibration pattern, select the *Target Points* tab and click the button labeled "Default 9 Points Full Screen". Press the <ESC> key to close the target point display.

To change the background color of the display, click the "Color" button, under "Full Screen Background Color", and select the desired color from the resulting color pallet. Each target point is a bit map image file specified under "Target Point Settings". To select a new bitmap file for any point, use the drop down menu to set "Index" to the desired point number, and click the "File" button to bring up a browser. Use the browser to select the desired bit map files and click "Open". To use the file for all target points, click the "Apply to All Target Points" button. Change the size of each target by adjusting the "width" and "height" values.

3.7 Connect *ETRemote* to multiple *ETVision* Systems

The most common reason for connecting *ETRemote* to multiple *ETVision* systems is to simultaneously send data recording or XDAT commands to multiple *ETVision* systems. In this case it may sometimes make sense to run *ETRemote* on one of the *ETVision* system PCs rather than a completely separate PC.

Install *ETRemote* on a PC running Win 10 or Win 11 operating system. Note that, if desired, this can one of the *ETVision* PCs. Be sure that the PC running *ETRemote* and the *ETVision* PCs are all connected to the same local area network (LAN).

Each *ETVision* IP address ("Ipv4") and port number (usually set to 51000) can be found on the *Network Configuration* dialog for that system as previously described. On each *ETVison* to be

connected to *ETRemote*, note the "Ipv4" address and "Server Port" number, and click the "Listen" button on the *Network Configuration* dialog. The "Listen" button will turn gray when clicked.

On the *ETRemote, Main* dialog tab, select "New Connection" from the "Connection" pull down menu. In the "Host" field, type in the Ipv4 address of the first ETV system to be connected. If the ETV system to be connected is running on the same PC as *ETRemote*, enter "localhost" in the "Connection" field rather than an IP number. Next to port, type in the port number (usually 51000) of the ETV system. Left click the "Connect" button.

If the connection is successful, the "Connect" button will change to "Disconnect" and the IP address and port number will appear in the "Connection" field.

Note that this is exactly the same process previously described for connection to a single *ETVision* system.

On the "Connection" pull down menu, choose "New Connection", and repeat the process for another ETV system. If a connection attempt is not successful (*ETRemote* "Connect" button does not change to "Disconnect" and new IP address does not appear in the "Connection" field), check to be sure that the "Listen" button was activated on the ETV system, *Network Configuration* dialog, and that the correct Ipv4 address was used.

When connections have been made, IP addresses for all connected ETV systems should appear on the "Connection" pull down menu list when the pull-down arrow is left clicked. If one of the ETV systems is using the same PC that is running *ETRemote*, that system will be listed as "localhost".

Now, if the "Broadcast command to all hosts" check box is checked, any actions in the "Host data file" group box, as well as clicking the "Set XDAT" button in the "Host Communication" group box, will apply to all connected systems. If the "Broadcast command to all hosts" is not checked, these actions apply only to the ETV system currently shown in the "Connection" field.

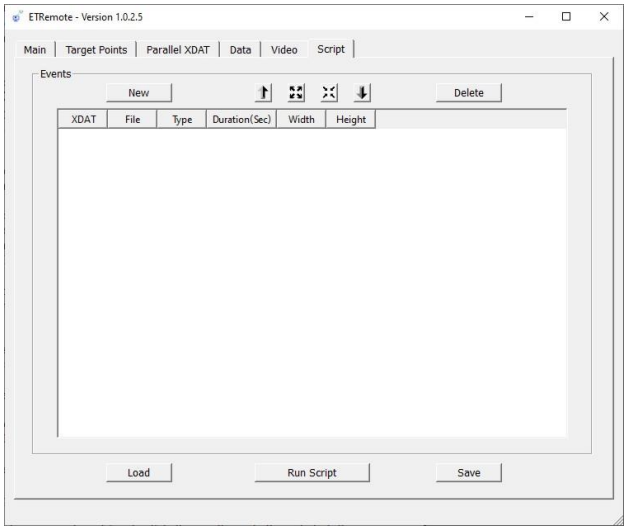
If the connection to any ETV system is lost (for example, if the connection is closed on the ETV system), then if the IP address for that system (or "localhost") is selected on the Connection pull down menu, the button in the "Host Connection" group box will be labeled "Connect" rather than "Disconnect". To re-connect, be sure the "Listen" button is activated on the ETS system *Network Configuration* dialog, and left click the "Connect" button on the *ETRemote* dialog.

Even if connected to multiple *ETVision* systems, *ETRemote* can receive data or video from only one of them. If one of the "Receive Data…" or "Receive Video" buttons is clicked, a data or video stream will be requested only from the ETV system currently selected on the "Connection" pull down menu.

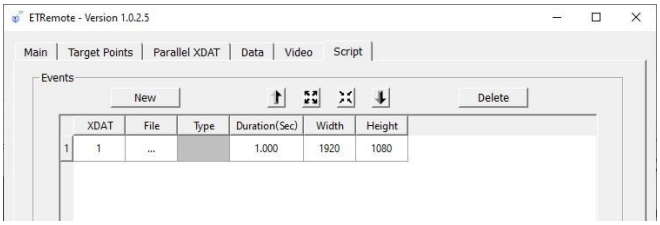
3.8 Create and run scripts to display a series of images or videos

ETRemote can create and run a simple script to present a series of images or videos while marking *ETVision* data with the beginning and end of each presentation event. More specifically, an XDAT value (integer of users choice) will be sent to *ETVision* to mark the beginning of each display event (time at which the image or video first appears), and a zero XDAT value will be sent to mark the end of each display event (time at which the image ceases to be displayed or the video ends).

To create a script, open the *Script* tab on *ETRemote.*



Click "New" to open the first event. A row of entries will open to specify the first event.



The XDAT column defines the value that will sent to define the start of the event. The XDAT start value will default to1, but can be changed to any other integer between 1 and 65535 by typing in a new value. (Although 0 can be chosen, it is suggested that the event start always be marked with a non-zero value since the event end is always marked by XDAT=0).

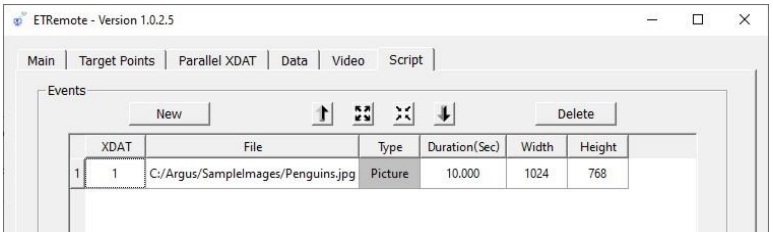
Under the file column, click the browse symbol and select either a bit map image file (jpg, png, or bmp), a video file (wmv, or avi), or a "gif" animation file.

If an image file is chosen "Duration" will default to 1 second, but can be changed by typing in a different value. If a video file or animation file has been chosen, the duration will default to the duration of the video or animation, but can be changed to a different value. The minimum duration

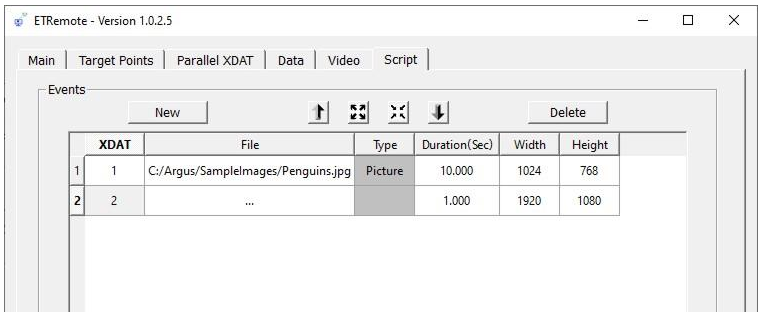
value for any event is 0.001 sec. If video or animation file duration is set to duration shorter than the length of the video or animation it will start at the beginning and end after the specified duration. If a duration value larger than the length of a video file is specified, the video will "freeze" and continue to display the last frame of the video until the duration expires. A gif file will continue to repeat until the duration expires.

The "Width" and "Height" values default to the resolution of the image or video file, but can be changed by typing in a different value. The "expand" button will cause the resolution of the item in the selected row to change to the current full screen display resolution. The "contract" button will return the item to the resolution specified by the image or video file. If no row is selected all events will be affected by the "expand" and "contract" buttons.

In the example below, a 1024 x 768, "jpg" image file is set to be displayed for 10 sec., with an XDAT value of 1 during the display.



Click the "New" button to add additional events. Each time "New" is clicked, a new event row will appear under the last row previously entered and the XDAT value will be default to the lowest integer not already chosen.

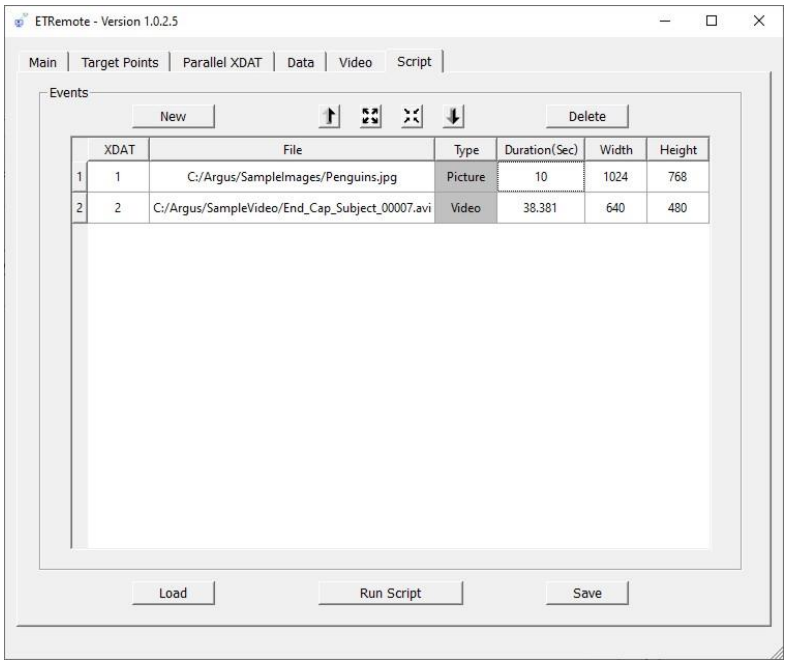


The "Delete" button will delete the currently selected event row. The up arrow button will move the currently selected row up one level. In other words, if the third row is selected the up arrow will cause that event to swap places with the event previously in the second row. The down arrow will move the currently selected row down one level.

If no row is highlighted, the resolution "expand" and "contract" buttons will re-set all events to full screen or original resolution.

To save the script, click "Save", and specify a path and file name. The file will automatically be given an "esf" extension. To load a previously saved script, click "Load" and browse to the previously saved "esf" file.

The sample script shown below will display an image called "penguins.jpg", followed by a 38.38 sec "avi" video called "End_Cap_Subject_00007.avi". XDAT will be 1 while the "penguins.jpg" image is displayed and 2 while the video is played.



To run a script, click "Run". The display will show the scripted images and videos (over a black background if the image is not full screen resolution), and then return to the normal desktop and *ETRemote* screen.

If *ETRemote* is not connected to the *ETVision* system, a warning message will appear when "Run" is clicked.

Click "Yes" to run the script anyway, but no XDAT values will be sent to the *ETVision* system until connected.

When a script is run, the sequence is as follows:

- the first event image (or first video frame) is displayed,
- the associated XDAT value is sent to *ETVision*,
- the specified event time elapses,
- XDAT=0 is sent to *ETVision*,
- the next event image is displayed,
- the associated XDAT value for that event is sent to *ETVision*, etc.

When recording data with *ETVision* the usual procedure would be to first open a data file on the *ETVision* PC and begin recording, then start the script on the display PC (PC running *ETRemote*). When the scrip finishes, stop recording on the *ETVision* PC.

When processing the resulting data with *ETAnalysis*, the usual procedure would be to have *ETAnalysis* parse the data into events by specifying each event "start condition" as the XDAT value associated with the event, and each event "end condition" either as XDAT=0 or as "any change" in XDAT. (Instructions for parsing data can be found in the *ETAnalysis* manual.)

Please note the following:
When the program commands a new display image the precise time for the image to actually appear on the display depends on the particular processor and display hardware as well as OS priorities. Therefore the precise time between the appearance of a new event image on the display and the associated XDAT value is variable. If an extremely precise relation between the begin event mark and the image appearance is required (for example, if attempting to measure a precise latency between image appearance and the beginning of a saccade) it is recommended that a more specialized display program be used.

3.9 Stream external PC display to *ETVision* PC (for display as "Stationary Scene Camera" video)

ETVision can display a window with external video ("Stationary Scene Camera video") from an external camera or network source in addition to the window showing video from the *ETVision* head mounted scene camera (see *ETVision* manual, section 7.10). It may sometimes be useful to have this "Stationary Scene Camera" window on *ETVision* show the stimulus image from the a monitor being viewed by the eye tracking subject. If the PC generating the stimulus image is running Windows 10 or Windows 11, *ETRemote* can be used to send the monitor image to the *ETVision* PC.

On *ETRemote*, *Main* tab, click the *Send Video TCP* or *Send Video UDP* button, under *Host Communication*. On the *ETVision*, *Stationary Scene Camera Configuration* dialog, Select "Network" from the "SSC" pull down menu, and from the "Type" pull down menu select the resolution and update rate specification. The resolution offered will be the resolution setting of the external PC graphics. Color type will always be RGB24, and update rate will always be 30 Hz.