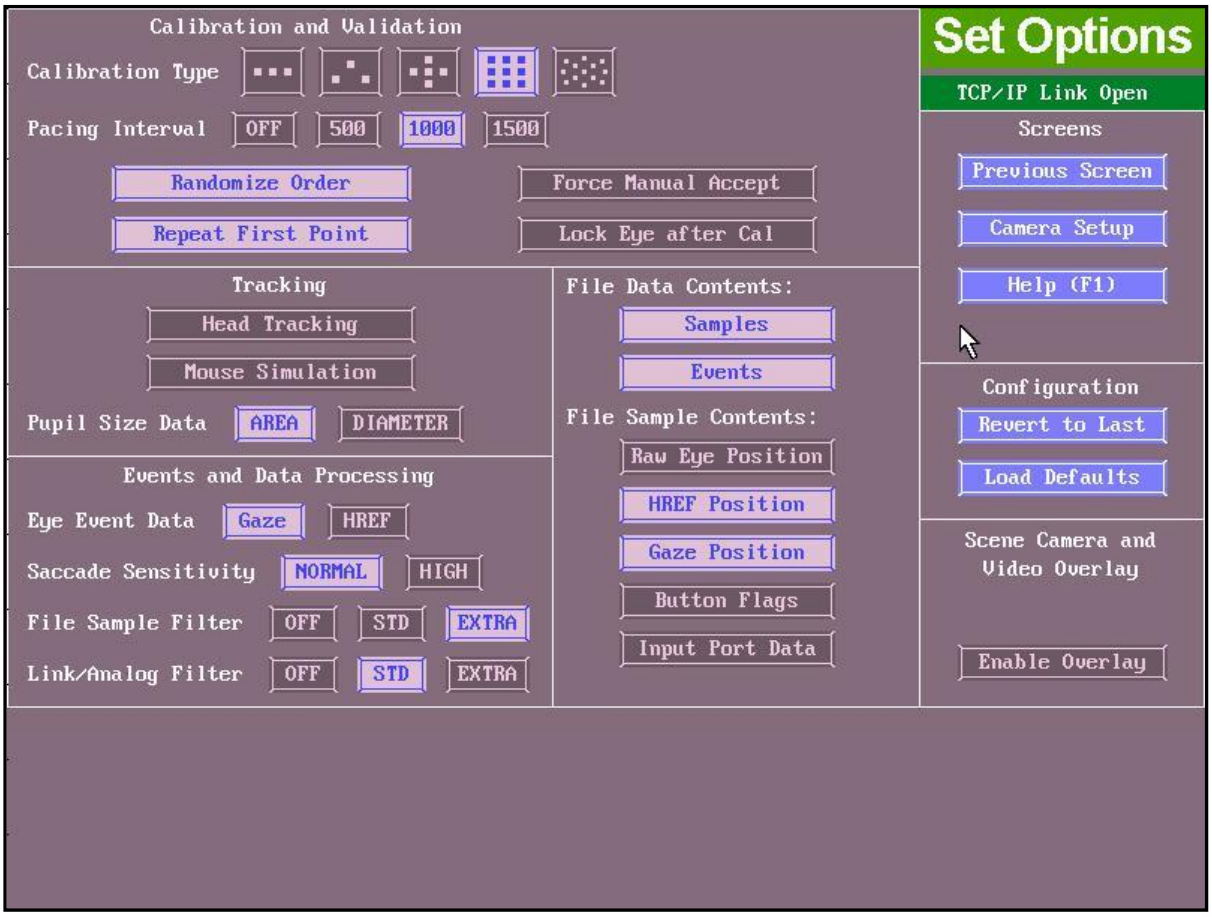
The MotionMonitor xGen Hardware Guide: Eyelink II Device Configuration

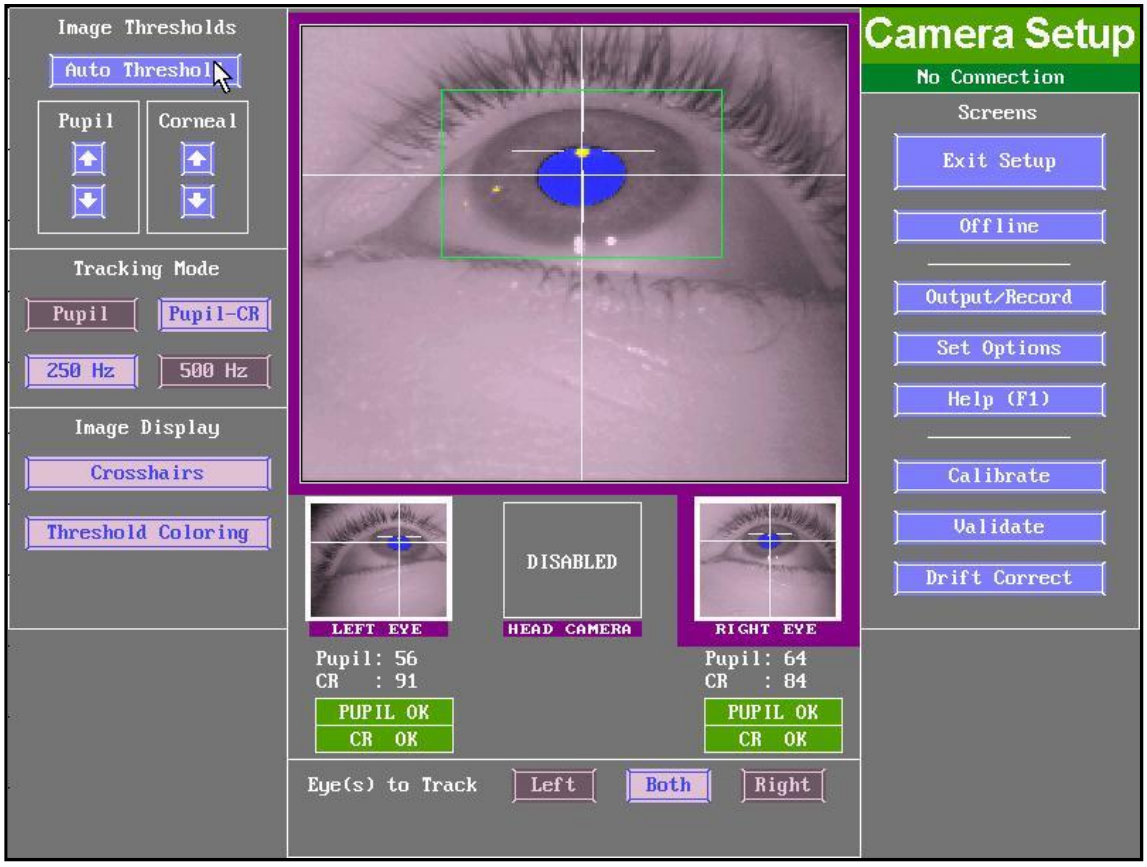
This document reviews the procedures for configuring the Eyelink II device in The MotionMonitor xGen software.

Before configuring the Eyelink II device in The MotionMonitor, it must first be configured on the Eyelink II server computer.

> If the Eyelink II Server Software has not started, enter “T” at the DOS prompt. In the Eyelink II Server Software, select “Set Up Options” and complete the choices as follows:



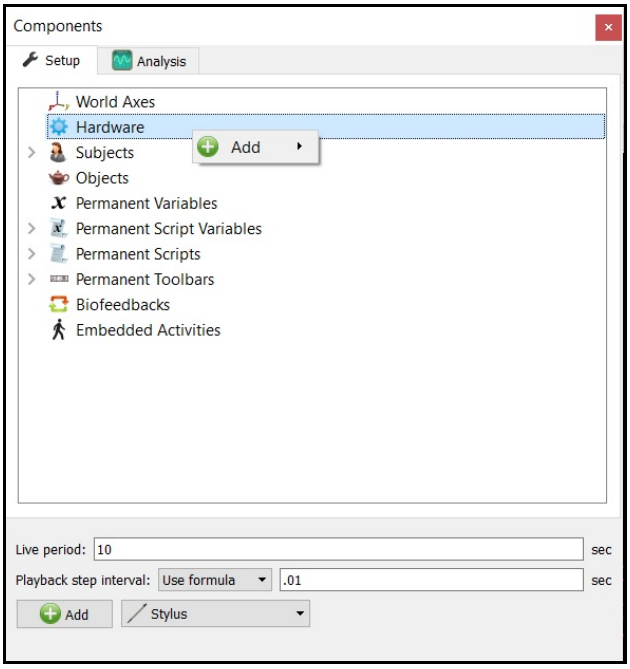
The “Camera Setup” button provides a means for focusing the cameras in preparation for usage. The Eyelink II Head Mount should be attached firmly to the head. Remove the lens cover for each camera and position them to display the eyes as shown in the following image. The IR Bar should be positioned even or below the eyebrows. See the Eyelink II manual for more information on Camera Setup.



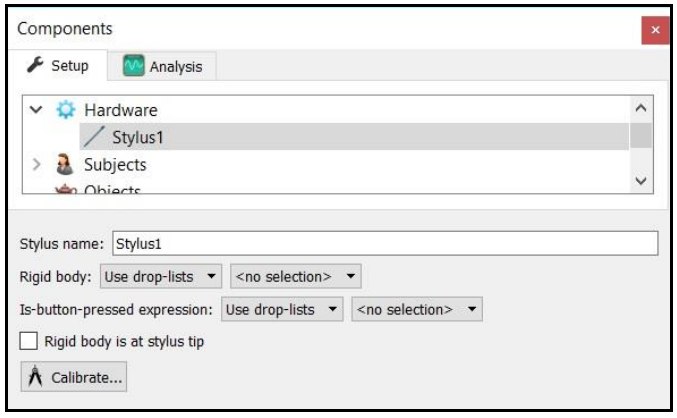
After positioning and focussing each camera, the auto-threshold button should be used to ensure good tracking of the pupil and corneal reflection. When focusing the camera, a good goal is a clear image of the eyelashes. Check that the Pupil OK and CR OK remain green as the subject focuses on each corner of the calibration screen.

1. Start The MotionMonitor xGen and go to the Setup Components Window. To calibrate and align the Eyelink II device, a subject and stylus will first need to be defined and calibrated.

2. If a stylus is not already defined in the current Workspace, go to the Hardware node in the Setup Components window and add the Stylus device through the "Add" button at the bottom of the Components window or right-click on the Hardware node to add the device.

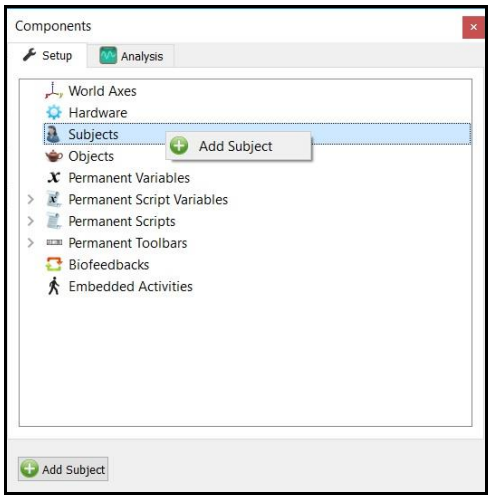


3. Before calibration of the stylus can be performed, the rigid body affixed to the object being used as the stylus needs to be selected through the "Rigid body" drop-list menu. If a remote OK button is to be used during the digitizing process, that Boolean expression would need to be defined through the "Is-button-pressed expression" drop-list menu or formula field. If the origin for the rigid body is at the tip of the stylus, as can be the case for certain kinematic tracking systems, the "Rigid body is at stylus tip" check box should be enabled.

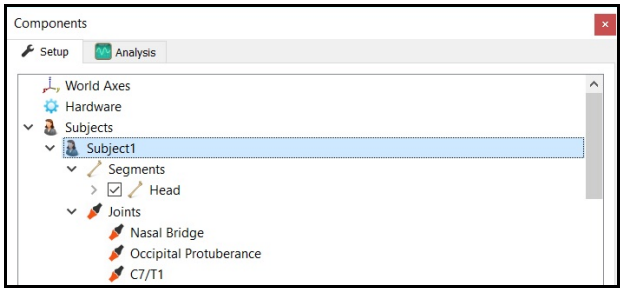


Once all parameter fields are completed, click the "Calibrate" button and follow the prompts to calibrate your stylus. A tutorial video for configuring the stylus can be found at https://themotionmonitor.com/support/.

4. If a subject is not already defined in the current Workspace, go to the Subjects node and click the “Add Subject” button at the bottom of the Components window or right-click on the Subjects node and select Add Subject.

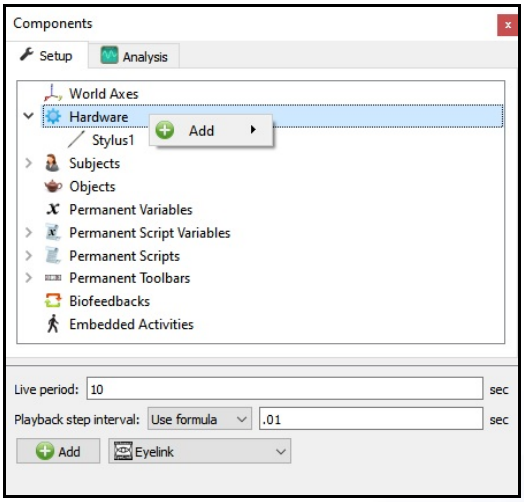


5. At minimum, the Subject’s Head Segment and Joints must be defined.



Click the “Calibrate” button and follow the software prompts to calibrate your biomechanical model. A tutorial video for configuring a subject can be found at https://themotionmonitor.com/support/.

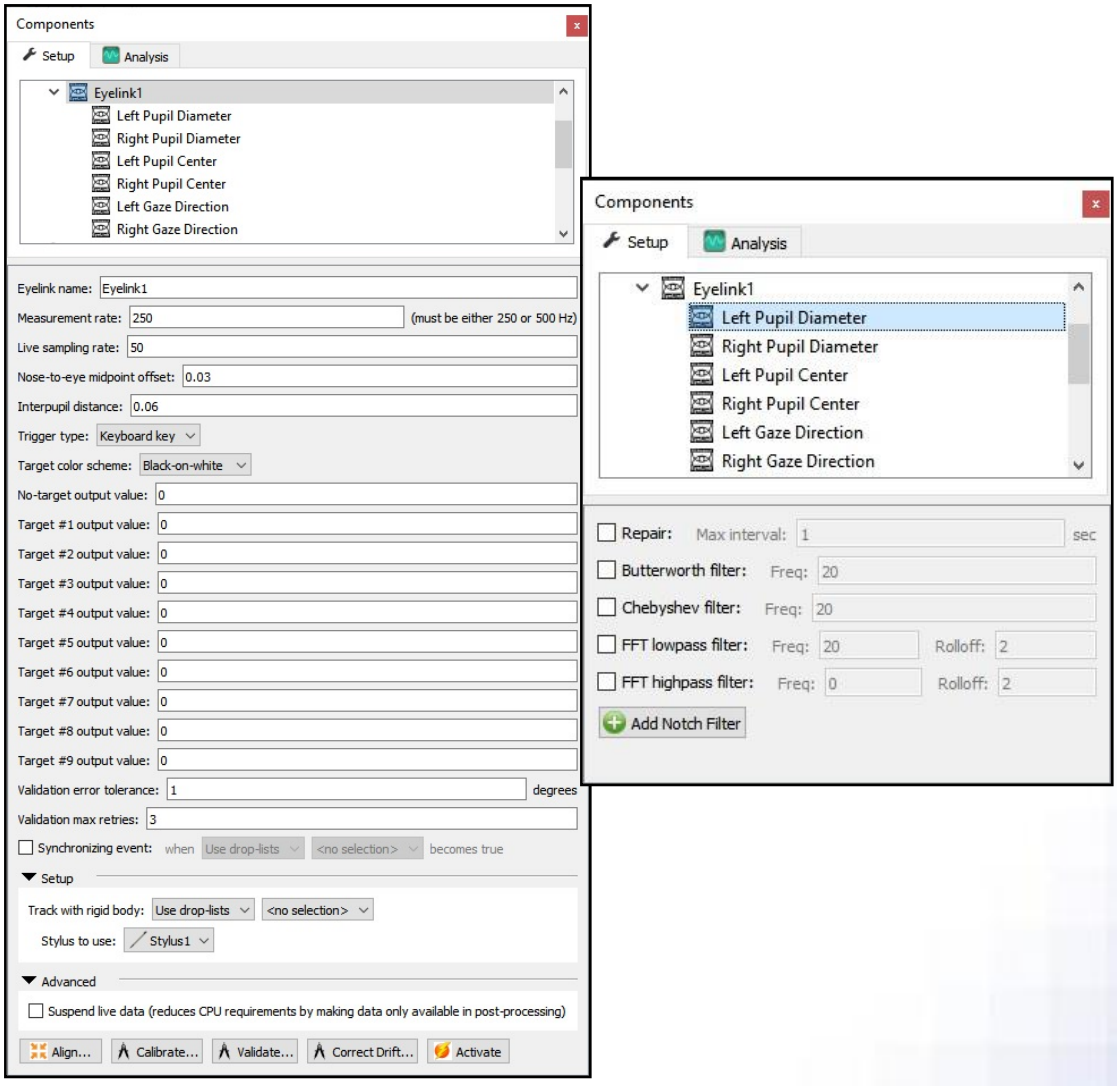
6. After the stylus and subject have been calibrated, the Eyelink II device can be configured. From the Hardware node in the Setup Components window add the Eyelink device through the “Add” button at the bottom of the Components window or right-click on the Hardware node to add the device.



7. From the Eyelink parameters panel, specify the Measurement rate and Live sampling rate fields. The Measurement rate needs to match the value specified in the Eyelink II server software, typically 250 Hz. This is the measurement rate at which data will be recorded. The Live sampling rate can be lower than the Measurement rate and specifies the measurement rate only for Eyelink data displayed in the Live window.

   The Nose-to-eye midpoint offset and Interpupil distances also need to be specified for the current subject, to locate the eyeballs' center of rotation. The inter-pupil distance should be obtained by using an Inter-Pupil Distance Measurement tool, or by measurement with a ruler. This entry should be made from direct measurement. Be sure that the subject is focused on infinity during the measurement. The nose-to-eye midpoint offset is the setback of the eyeball center of rotation and is a less sensitive measurement. One can usually rely on anthropometric data for this entry.

   The "Trigger type" selects the method for advancing targets during the validation procedure. This can either be selected as "Keyboard key" or "Stylus button". The "Target color scheme" for the calibration and validation targets can also be selected as "Black-on-white" or "White-on-black".



Outputs, or “Prompts”, will report a value based on the state of the targets during the calibration routine for the duration that each target is active. The value to be output is specified in the dialog, under “No-target output value”, “Target #1 output value”, etc. The idea here is that external prompts can be used to activate LEDs or other representations of the calibration points on large calibration planes.

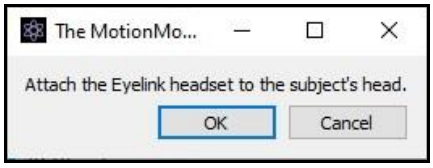
The calibration process involves a validation step. The subject should maintain the same physical orientation to the display during calibration and validation. In validating the calibration, eye angles computed during validation are compared to the eye angles computed during the calibration phase. If the error tolerance is larger than the limit specified in the dialog, “Validation error tolerance”, the calibration point will be presented again. The number of times that a calibration point will be presented is controlled by the “Validation max retries” edit field. Once this limit has been reached, the validation errors are accepted regardless of the error tolerance specified in the dialog. The final average and maximum error values for both eyes are displayed on the Eyelink Server computer at the end of validation.

Under the Setup node, select the same rigid body that was assigned to the Head Segment of your Subject for the “Track with rigid body” field and select your stylus from the “Stylus to use” drop-list.

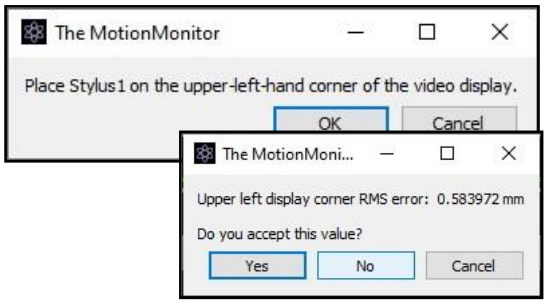
Click the “Activate” button when all parameters have been specified.

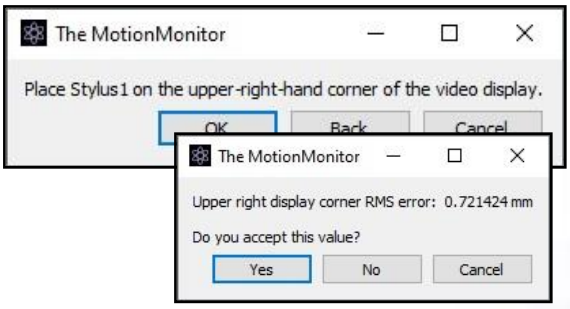
The “Align” and “Calibrate” buttons will be reviewed in the following steps. The “Validate” and “Correct drift” buttons will be reviewed at the end of the document.

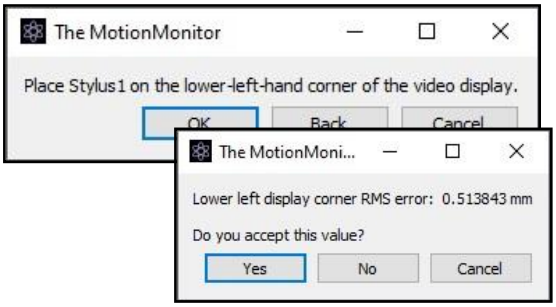
8. The Alignment process needs to be completed for each subject setup. Click on the “Align” button and follow the prompts to align your Eyelink device with the subject and kinematic tracking system.

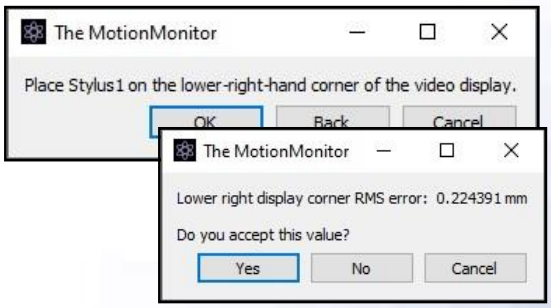


The corners of the calibration screen need to be digitized. After each reading, an RMS value will be reported for the location of the digitized point.

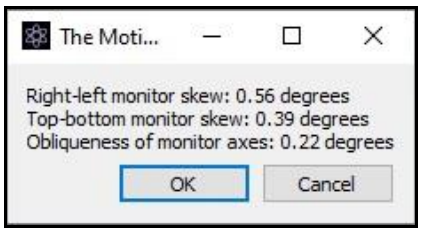




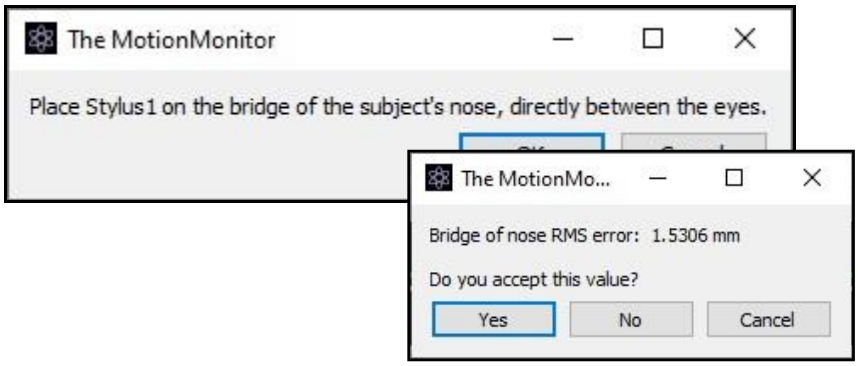




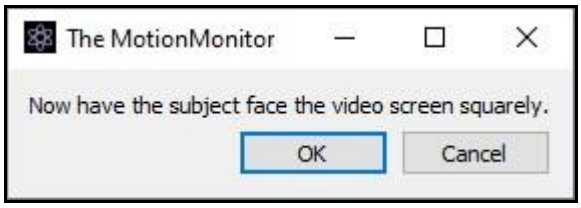
After digitizing all 4 corners of the calibration screen, the results for the monitor skew will be displayed.



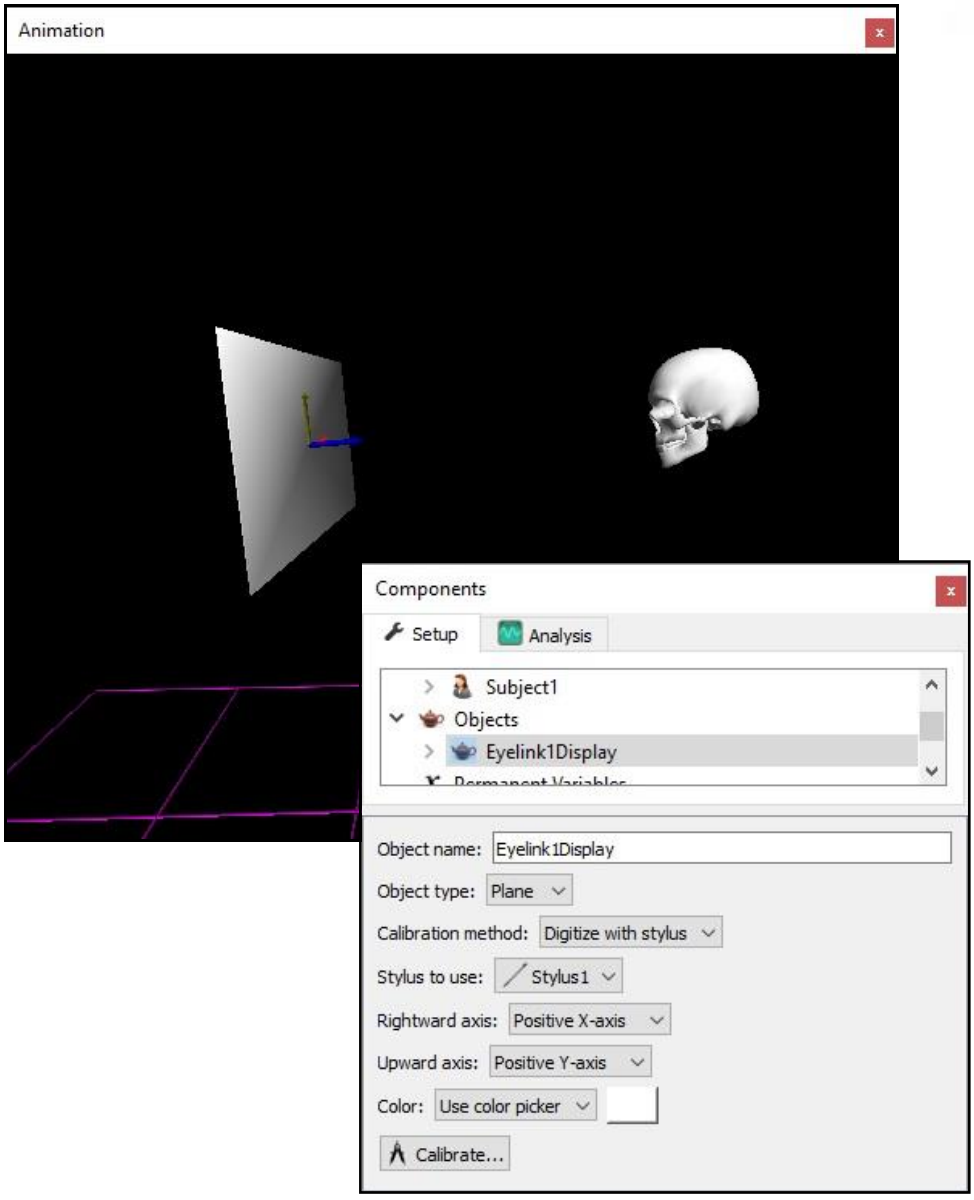
Next, the location of the bridge of the subject's nose is digitized, followed by an RMS error for the digitized location.



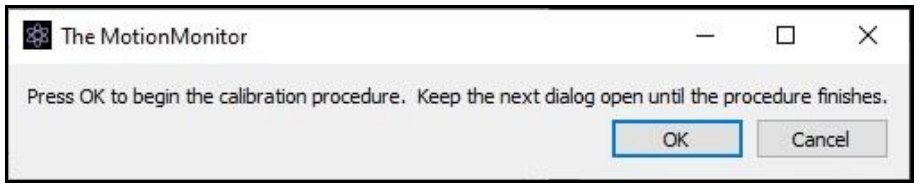
Finally, the subject should squarely face the calibration screen for a final alignment reading.



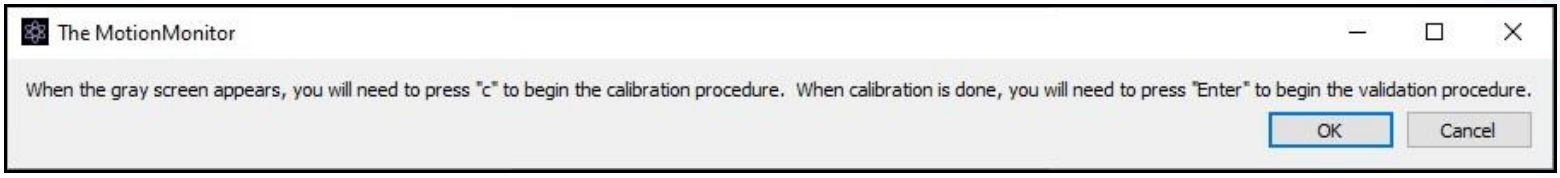
When the alignment process is completed, the calibration screen will be automatically added to the Objects node in the Setup Components window as “Eyelink1Display”. For more information on defining Objects or Planes and determining the Eyelink gaze vector intersection, please refer to the “Adding Objects to the Animation Window” knowledge base article.



9. The Calibration process needs to be completed for each subject setup. Click the “Calibrate” button and follow the prompts to calibrate your Eyelink device.

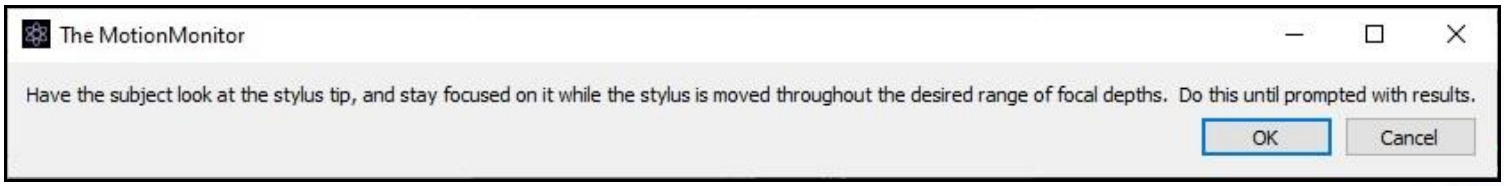


When the gray screen appears, press “c” and then the space bar to begin the calibration procedure. The calibration points will automatically advance.

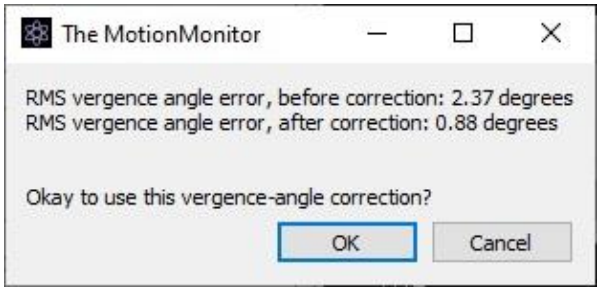


At the end of the calibration procedure, click “enter” and “O” to begin the validation procedure. Note that on some systems the procedure may advance without the need to click “O” on the keyboard. The validation points are manually advanced based on the “Trigger type” selected in the Eyelink parameters panel when the subject is fixated on the currently displayed target.

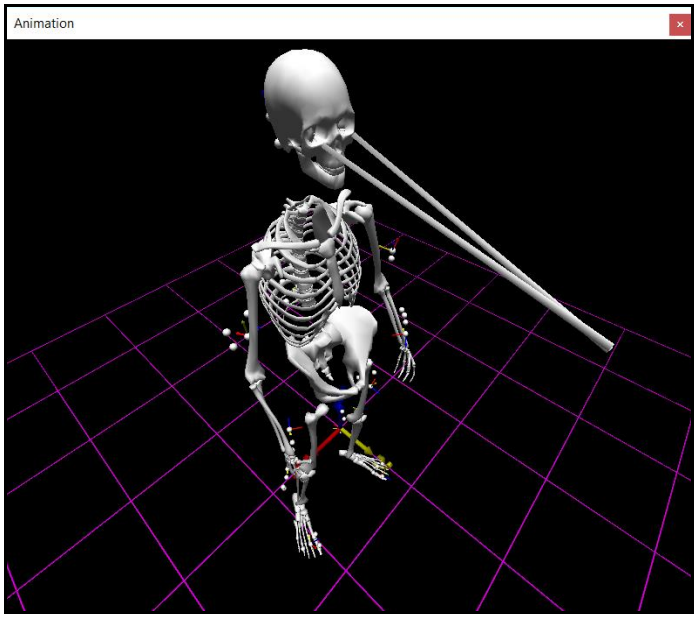
Upon completion of the Validation procedure, the vergence angle is calculated by having the subject fixate on the stylus tip.



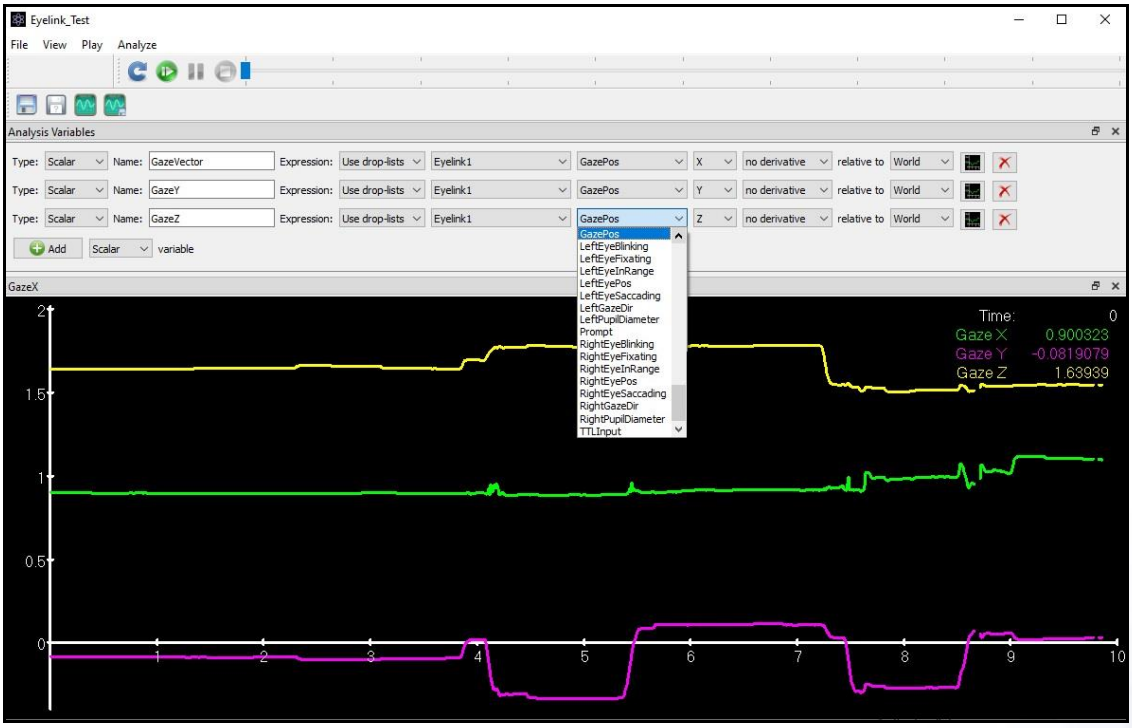
If the calibration was successful, the following dialog will be presented with the RMS vergence angle error.



10. Once the Calibration and Alignment procedures have been completed for the Eyelink device, the eye vectors should appear in the Animation window. The Eyelink device is now successfully configured.



11. Eyelink data can be defined as Analysis Variables and plotted in Graphs as seen in the image below. Tutorial videos for adding variables and graphs can be found at https://themotionmonitor.com/support/.



The Eyelink hardware device provides the following data types:

Gaze Position – Calculated 3D position of the right and left gaze direction intersection point.

Eye Status – Includes the identification for Eye Blinking, Eye Fixating and Eye Saccading events.

Eye in Range – Indicates whether the gaze direction data is within the calibration limits.

Eye Position – Data returns the location of the eye's center of rotation relative to the selected reference frame. These data are computed from the digitized bridge of the nose adjusted for the Inter-Pupil Distance and Setback Distance

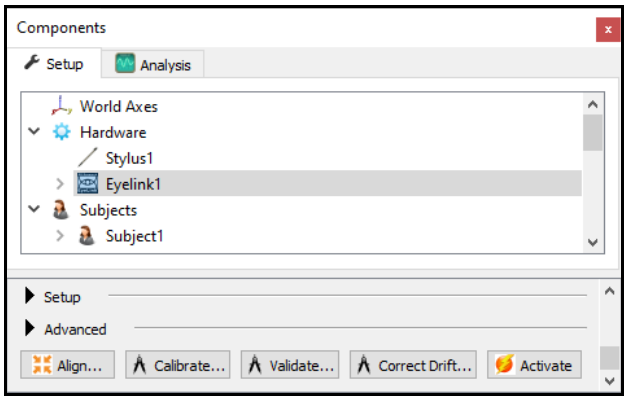
Gaze Direction – Data returns the location of a unit vector emanating from the eye's center of rotation.

Pupil Diameter – Returns the measured diameter of the pupil.

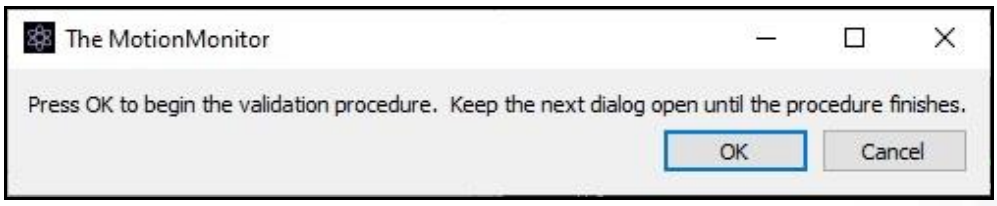
TTL – Returns the TTL input signal connected to the Eyelink Server computer.

Prompt – Returns the value for the output, or "prompt", configured through the Eyelink parameters panel.

12. Following the initial calibration of the Eylink device, it may be desirable to validate or correct the existing calibration without going through the entire calibration procedure that was previously outlined. The "Validate" and "Correct Drift" buttons allow you to perform such procedures.

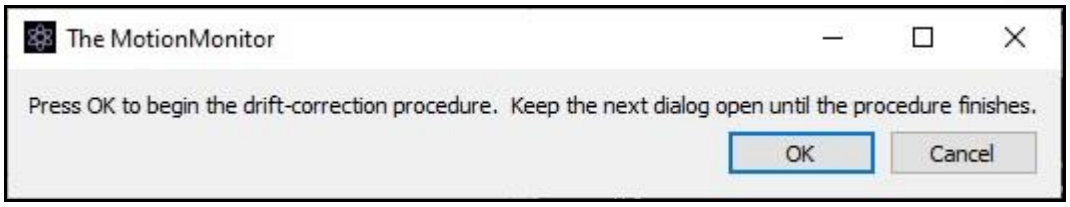


The Validation process is performed as part of the calibration process but may also be activated at any time after calibration to determine if the original calibration has been in-validated because of significant movement in the head mount or sensor slippage.



The validation points are manually advanced based on the "Trigger type" selected in the Eyelink parameters panel when the subject is fixated on the current displayed target. If the error results of the validation process are unacceptable to the user, the calibration should be repeated using the "Calibrate" button.

Drift Correction is used to adjust the Eyelink II eye tracker calibration after a subject has been calibrated with the Eyelink Tracker. The purpose is to account for slight headset movement after calibration. If there is significant headset or sensor movement the subject should be recalibrated using the “Calibrate” button. Click on the “Correct Drift” button to being this process. Once initiated, use the space bar to proceed through the correction process.



The process is similar to the validation, except only one point will be presented at the center of the screen. The subject should resume their head position and orientation taken during the original calibration and fixate on this point. Use the selected trigger method to proceed through the procedure.

In correcting drift, eye angles computed during calibration are compared to the eye angle readings taken during drift. If the error is larger than the Validation Error Tolerance specified in the Eyelink parameters panel, the point is presented again. This process repeats until the “maximum number of validation attempts” is reached. The final error reading will then be accepted, even if it is greater than the Validation Error Tolerance. Error values for the left and right eye are reported on the Eyelink Sever. The drift error value is then used to adjust the calibration readings.