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Optotrak 3020 and Optotrak Certus: Integrating the ASL Eye-Trac 6000

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Responsibilities

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1 Introduction

This document provides instructions for integrating the ASL Eye-Trac with the Optotrak® 3020 and Optotrak® Certus™ systems. The integration allows you to synchronize eye and head position data during experiments and research trials. Read this entire document before starting the integration, and complete each section in sequence.

1.1 Scope

The scope of this document is limited to providing general guidelines for successfully integrating the Optotrak system with the ASL Eye-Trac 6000 system. For more detailed information about the steps and actions presented in this document, see the appropriate Optotrak or ASL documentation.

1.2 Conditions

To use this document, you must be familiar with the Optotrak and Eye-Trac systems, and you must meet the following conditions:

- As reference material, you should have ASL's *"EYEHEAD Integration Instruction Manual"*, ASL's *"Eye Tracking System Instructions"* (for the Eye-Trac 6000), the *"Optotrak System Guide"* or the *"Optotrak Certus User Guide"*, and the *"First Principles User Guide"*.

- You must have the ASLEyeTracker plug-in, supported by NDI First Principles™, installed on the Optotrak computer. If you have any problems installing or using the plug-in, or to obtain a copy of this plug-in, contact NDI Technical Support (See page 10).

- You must be running ASL Eye-Trac 6000 User Interface version 6.07.01, or higher; and control unit DSP program version 6.07.01 or higher. Run the ASL "Eye-Trac 6000 User Interface" program and click **Help, About** to see these version numbers.

- The software for both systems should be installed on separate Microsoft® Windows® platforms.

- You must have an NDI digitizing probe configured and initialized with the Optotrak system.

- You must use ASL Method 2 for eye calibration.

2 Preparation

Prepare for the integration by completing the following tasks:

1. Build a rigid body to attach to your ASL headband.

   The rigid body must have at least three markers and be constructed such that the markers will not move relative to each other during normal operation. Figure 1 is an example of a rigid body with six markers. Figure 2 shows a three-marker design harnessed to the Eye-Trac.

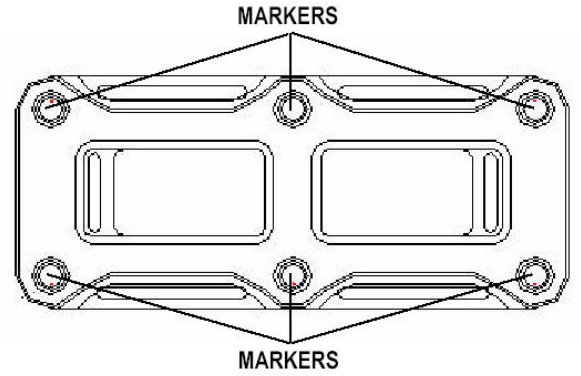

Figure 1 Six-Marker Rigid Body Design Example

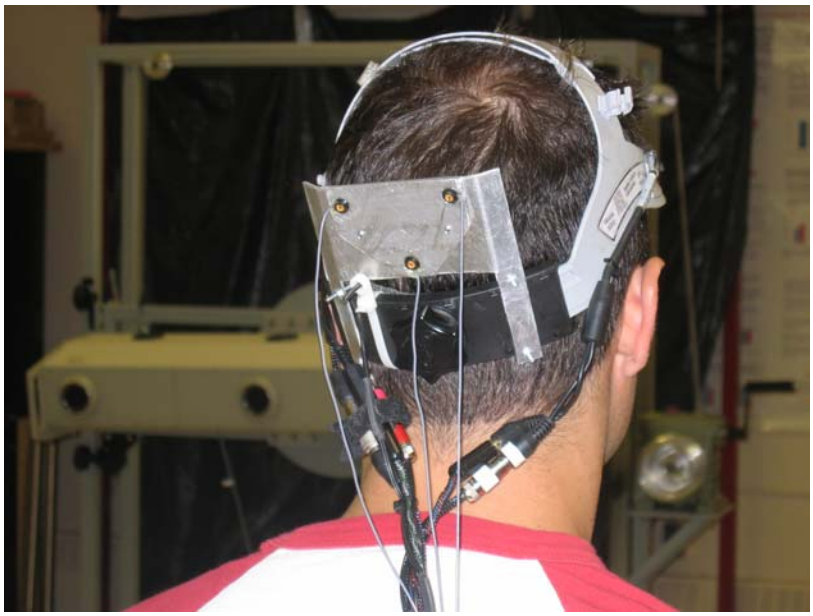

Figure 2 Eye-Trac 6000 Integrated with a Three-Marker Rigid Body

2. Use NDI 6D Architect to construct a *.rig* file for the rigid body.

3. Connect a double female-end, 9-pin (RS232) null modem cable to the Optotrak host computer's **COM** port and the Eye-Trac Control Unit's **Head Tracker** port.

4. Use a hard, flat surface (such as a wall or bristle board) to mark out a 3 X 3 point grid as specified in the *"EYEHEAD Integration Instruction Manual"*.

5. Determine the position of each of the nine points relative to the middle point (point 5) using the ASL coordinate frame format.

   The coordinate frame **y-** and **z-axes** must lie on the surface, with **y-axis** units increasing from left to right and **z-axis** units increasing from top to bottom. Specify eye calibration point 5 as the origin of the calibration plane coordinate frame (y=0, z=0). See the "Environment Specification" section in the *"EYEHEAD Integration Instruction Manual"* for more detailed instructions.

6. If you have not already done so, register and align the Optotrak Position Sensor(s) as described in the Optotrak documentation and in accordance with the purpose of your trial.

   Note: The Optotrak system coordinate origin should be as close to the Position Sensor(s) as possible, but no more that 6 meters from the furthest plane in the scene.

3 System Triggering (Optional)

To synchronize ASL and Optotrak data you can use an external trigger signal from the Optotrak system to trigger data recording on the ASL system.

1. At the back of the Optotrak SCU, locate the **External Synchronization Port**.

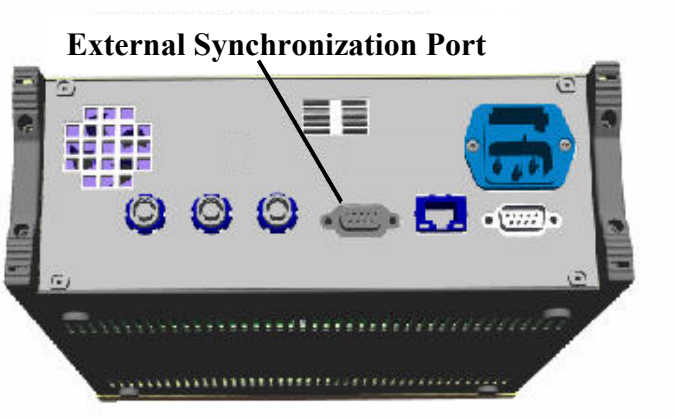

Figure 3 Optotrak Certus System Control Unit (Back View)

2. To configure the External Synchronization Port, choose one of the following options:

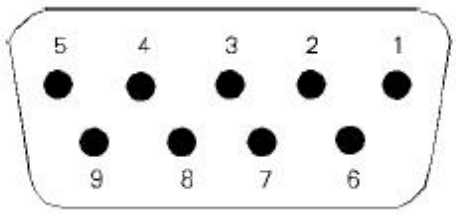

Figure 4 Optotrak External Synchronization Port Pin Arrangement

- If you are using an Optotrak 3020 SCU, use pins **1** and **5** for the external trigger "OUT" signal. Place a **33 ohm** resistor between pins **1** and **5** and then invert the signal.

- If you are using an Optotrak Certus SCU, use pins **1** and **8** for the external trigger "OUT" signal. Place a **33 ohm** resistor between pins **1** and **8** and invert the signal.

  Note: The signal between pins must be inverted for the triggering to function correctly.

3. Connect the external trigger "OUT" signal from the Optotrak SCU's **External Synch Port** to the data bit 15 (pin 1) of the ASL control unit's **XDAT** port. Connect all other data bit pins on the **XDAT** port (pin 2-15, and pin 17) to a ground pin (pins 18-25 on the **XDAT** port), or to data bit pins on another device that produces TTL level logic values.

   For detailed information about configuring the **XDAT** port, see the subsection titled "Auto FILE OPEN and RECORD feature" and the section titled "Using the XDAT port" in ASL's *"Eye Tracking System Instructions"*.

   Note: If your experiment requires an external trigger "IN", you can continue to use that option.

4 ASL Software Configuration

1. On the ASL computer, start the Eye-Trac 6000 User Interface and load the Optotrak DSP file you have obtained from ASL.

2. On the ASL computer, in the **Eye-Trac 6000 User Interface** window, click **Configure** > **System Settings**.

3. Enable the **Use Metric System** and **Auto Record** check boxes and click **OK**.

4. Click **HDT** > **Setup Head Tracker**.

5. Select **NDI Optotrak** from the **Head Tracker Type** drop-down menu and click **OK**.

6. Click **EyeHead** > **Setup**.

7. Click the **General** tab.

8. Set **MHT Transmitter Offsets in Transmitter Coordinate Frame** values to zero.

9. Have a participant put on the Eye-Trac headband (with rigid body attached).

10. Use the digitizing probe to determine the position of the participant's eye with respect to the headband's rigid body (expressed in the rigid body coordinate frame), and type these values in the X, Y, and Z fields labelled **MHT Sensor to Eye Vector Coordinates in Sensor Coordinate Frame**.

11. Enable the **Place sensor directly on points** radio button and the **Record Integrated EyeHead Data** check box.

12. Next to **Number of Scene Planes not Including Calibration Plane**, enter the number of additional scene planes that will be used. Note that at least one plane, which serves as the calibration surface, is required, so the dialog asks for the number of scene planes in addition to the calibration surface. If the calibration surface will be the only scene plane, then 0 is entered for this item. Refer to ASL *"EyeHead Integration Instruction Manual*" to be sure other items on this dialog are entered correctly.

13. Click the **Calibration Scene Plane** tab and enter the location of 9 calibration target points on your calibration plane (also known as plane 0). See ASL's *"EyeHead Integration Instruction Manual"* for details.

    Note: Set the 0,0 coordinate at point 5, and remember that the ASL coordinate frame has the **y-** and **z-axes** lying on the surface, with **y-axis** units increasing to the right and **z-axis** units increasing downwards. All values should be in centimetres.

14. Click **the Individual Scene Plane** tab, and enter the required data for scene plane zero, including the location, in scene plane coordinates for points **A, B**, and **C**, as defined in the "Individual Scene Plane Parameters" section in the *"EyeHead Integration Instruction Manual"*. Note that for scene plane zero, it is recommended that calibration points 9,7, and 1 also be used as points A, B, and C. This can be done by clicking **Set from Calibration Points 9, 7, 1**, in the section labelled **Point ABC Coordinates in Scene Coordinate Frame.**

15. If more than one scene plane is to be used, also enter the scene plane boundary values in the section labelled **Rectangular Scene Plane Boundary**. Note that the **Top** and **Left** values should be negative.

16. Enter all information for the other surfaces to be used as scene planes, referring to the ASL *"EyeHead Integration Instruction Manual"* for details.

17. Click **Apply** and then click **OK** to close the **System Settings** window.

    Note: The values entered above should remain unchanged. If all the trial planes and variables remain the same, you should not have to alter these settings again.

18. On the Optotrak computer, launch NDI First Principles and perform the following two steps:

    i. Select **Experiment Setup>Rigid Body Setup** and create an experiment in which both the digitizing probe and the Eye-Trac headband rigid bodies are present.

    ii. Select **Collection>Calculations** and add the **ASLEyeTracker** calculation. Specify the digitizing probe as the calculation input. Select **Close** and proceed to the next step.

5 ASL Plane Calibration

1. On the ASL computer, in the **Eye-Trac 6000 User Interface** window, click **HDT** > **ENABLE**.

2. Verify that the digitizing probe's transformation data are detected by the ASL system by comparing the **X**, **Y**, and **Z** values displayed on the ASL and Optotrak computers.

   Note: The only difference should be that the Optotrak values are in millimetres and the ASL values are in centimeters.

3. Click **EyeHead** > **Setup**.

4. Click the **Individual Scene Planes** tab:

    i. See the "Individual Scene Plane Parameters" section in the *"EyeHead Integration Instruction Manual"* for an explanation of points "A", "B", and "C".

    ii. After determining which points are A, B, and C, click the **Set with Sensor** button.

    A window appears and you are prompted to hold the digitizing probe over the appropriate point.

    iii. Place the probe over point **A** and click the **Set** button.

    Under **Point ABC Coordinates in Transmitter Coordinate Frame**, the value for the **Point A** field should change to display the location of point **A** with respect to your coordinate system origin.

    iv. Repeat step **iii** for points **B** and **C**, and for all planes (always in the order A, B, C).

    v. When this procedure is complete, the values listed under **Point ABC Coordinates in Transmitter Coordinate Frame** should display the location of points **A, B,** and **C** with respect to your coordinate system origin.

6 Final Setup

1. On the Optotrak computer, change the calculation input for the ASLEyeTracker calculation so that the Eye-Trac headband's rigid body transformation is selected instead of the digitizing probe.

2. Go to the **Eye-Trac 6000 User Interface** on the ASL computer and click **HDT** > **Reset Head Tracker**.

   The **X**, **Y**, and **Z** values should update to correspond to the headband's rigid body values.

3. In the **Eye-Trac 6000 User Interface** window, click **EyeHead** > **Integrate** > **Display Data**.

4. See the ASL documentation to calibrate the participant's eye using *Method 2*.

5. In the **Eye-Trac 6000 User Interface** Select **File > New,** and use the browser window to name a data file.

   If you have configured the two systems for synchronization (see section 3), each time the Optotrak computer begins a collection the ASL computer will collect for the duration of the trial. The ASL computer will stop collecting when the Optotrak computer stops collecting. At this point you can close the ASL data file and open a new one for the next trial, or simply allow the next trial to be recorded as another "segment" on the same ASL data file.

7 QUESTIONS?

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