

DPI eye tracker testing

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1 Tests

In general, we want to make sure that we can robustly track both artificial and human eyes and that the noise and overshoot levels are consistent with previous tests [[link to previous report]]. Steps 1-3 below test that the eye tracker is basically working. If this works, move on to steps 4-7 to test the noise and dynamics of the tracker more thoroughly *without modifying the DPI configuration!!!*.

1. **Stationary Artificial Eye:** test static noise levels
2. **dynamic Artificial Eye:** 1Hz , 1V amplitude square wave - quick test of tracking range (amplitude voltage of 1Hz is approximately 3°)
3. **Real Eye:** test that DPI can track human eye with *same* settings as in steps 1 and 2
 - (a) Fixation
 - (b) 9 point grid
4. **Artificial Eye Dynamics:** examine overshoots, resolution, tracking range
 - (a) Square, sine, and triangle waves of varying frequencies and amplitudes
 - (b) resolution: 1 arcmin, 1 Hz square wave (compare to Fig 1)
5. **Static Artificial Eye - Long:** test the slow drift of the eye trackers (3-10 minute stationary recording as in Fig 2)
6. **Real Eye Dynamics**
 - (a) large 9 point grid (targets on wall or laser pointer) - examine tracking range and saccadic overshoots
 - (b) smooth pursuit - laser pointer
7. **Artificial Eye again:** check that we can still track artificial eye

2 Recording and Analysis

2.1 Tracking the Artificial Eye

The artificial eye can be mounted on the stage for stationary recordings or mounted with the galvo for dynamic measurements. In either case, place the filter over the 1st image detector. To focus, manually move the artificial eye back and forth within the stand.

For dynamic recordings, mount the artificial eye as shown [\[\[take a picture\]\]](#) so that it is driven by a signal from the function generator through the amplifier. The conversion factor from voltage to arcmin is written on the amplifier. For basic instructions on how to operate the function generator visit the Tektronix manual (page 2-14).

2.2 Tracking a human eye

See basic instructions on google drive. Note that Warren will likely be changing the marks on the DPI display.

2.3 Recording data

To record, ensure that the DSP is properly connected (Fig 3) and the computer is turned on (password on keyboard). Open `C:/EyeRIS/demos/demos.sln` in VisualStudio2013.

There are two main options for recording data. In the solution manager, right click the one you want to use and **Set as start up project**. The project will be shown in bold face if this is already done.

- For artificial eye recordings: **TestDPIPrecision**
 - `params.cfg`: modify `numbTrial` and `fixTime` to change the number of trials or trial duration respectively (defaults should be 3 trials and 10000ms)
 - data is saved to `C:/EyeRIS/demos/TestDPIPrecision/data/ArtEye`
 - This experiments is over when the central red dot disappears.
- For human eye recordings: **C:/EyeRIS/demos/DoubleCalibPrec** - this experiment includes the auto and manual calibration processes.
 - `params.cfg`: nothing too important unless you want to change the background color or subject name
 - data is saved to `C:/EyeRIS/demos/DoubleCalibPrec/Rec_data/Test`

- The subject goes through the automatic and manual recalibration procedures, then can go through a 9 point grid as many times as desired by pressing R1.

When you get to the exit screen, the experiment is over and you may press `Exit` in the console. If the experiment continues after this you will get an error because the binocular system is attempting to repeat the process with the second eye (I think).

Save the recorded trials (.eis files) into a folder and copy it into the Google Drive folder (`C:/users/aplab/GoogleDrive/ArtificialEyeData`) to transfer it to the other computer for analysis. (This way you can continue making recordings while you look at data!)

3 Notes

- $5\text{mV} \approx 1 \text{ arcmin}$
- For reference, a stationary eye report from April 2017 is (Apr2017) is included with the shared google drive.

3.1 Matlab analysis

Full matlab code is available on gitlab. Note that you will also need the EMAT toolboxes on gitlab to run on your own computer.

Log on to the aplab account (password label on computer). **Open MATLAB as administrator.** To do this right-click on the icon, right-click on the icon again, select open as administrator.

Artificial Eye Data

- Code: main script `C:/Users/aplab/Documents/MATLAB/DPITesting/ProcessArtEyeData_Final.m` with supporting files in the same folder.
- Change the name of the directory containing data in line 13. The file path should already go to the Google Drive folder containing data.
- For a quick look at one of the trials, run the first three cells to load the data and plot the horizontal and vertical traces.
- Run the entire script to produce a full report. In the command line, include any notes when prompted ("Any important notes to include?"). The script outputs:
 - Horizontal and vertical traces for one of the trials in individual figures.

- Figure with traces and power spectra of three trials (saved for .tex report)
 - Table of noise levels: rms and standard deviations (saved for .tex report)
 - Histograms of horizontal and vertical positions (saved for .tex report)
 - .tex file to produce a pdf report (C:/Users/aplab/GoogleDrive/ArtificialEyeData/LatexReports)
 - .mat files with data (in original data directory)
- If you want to compile the L^AT_EX report into a PDF, navigate to the LatexReport folder and the subfolder for the current data. Open the .tex file (opens automatically in TeXStudio). To compile, press the double green arrow in the menu bar. This will produce and display a PDF file in the same folder.

Human Eye Data

- Code: main script C:/Users/aplab/Documents/MATLAB/DPITesting/ProcessDoubleCalibPrecData.m with supporting files in the same folder.
- Change the name of the directory containing data in line 11. The file path should already go to the Google Drive folder containing data.
- Running the entire script to produce and save figures. The script outputs:
 - Horizontal and vertical traces for one of the trials in individual figures.
 - Plot of gaze positions (y vs x)
 - figures saved to C:/Users/aplab/GoogleDrive/ArtificialEyeData/HumanEyeFigures

4 Reference Figures

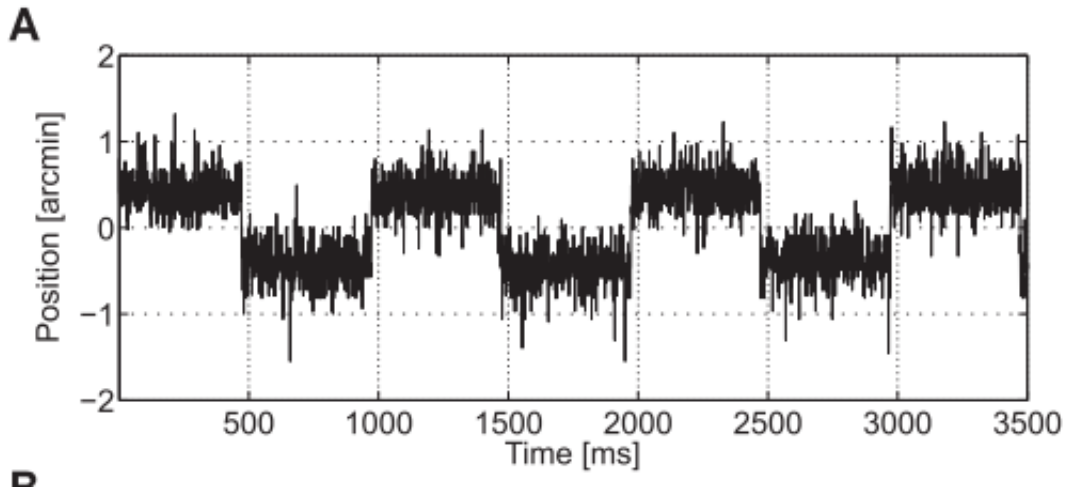


Figure 1: right DPI resolution. 1Hz, 1 arcmin square wave from Ko et al. (2016), Fig 4A

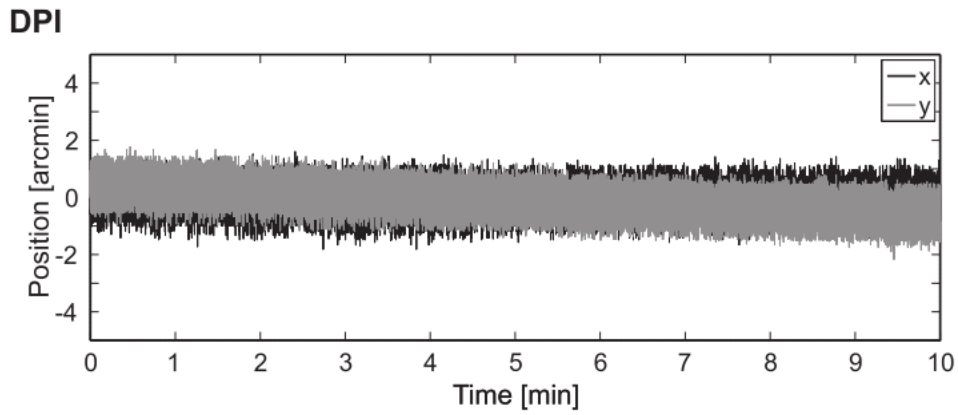


Figure 2: right DPI slow drift from Ko et al. (2016), Fig 3A

5 Miscellaneous Instructions

5.1 Connecting *one* DPI to the binocular DSP

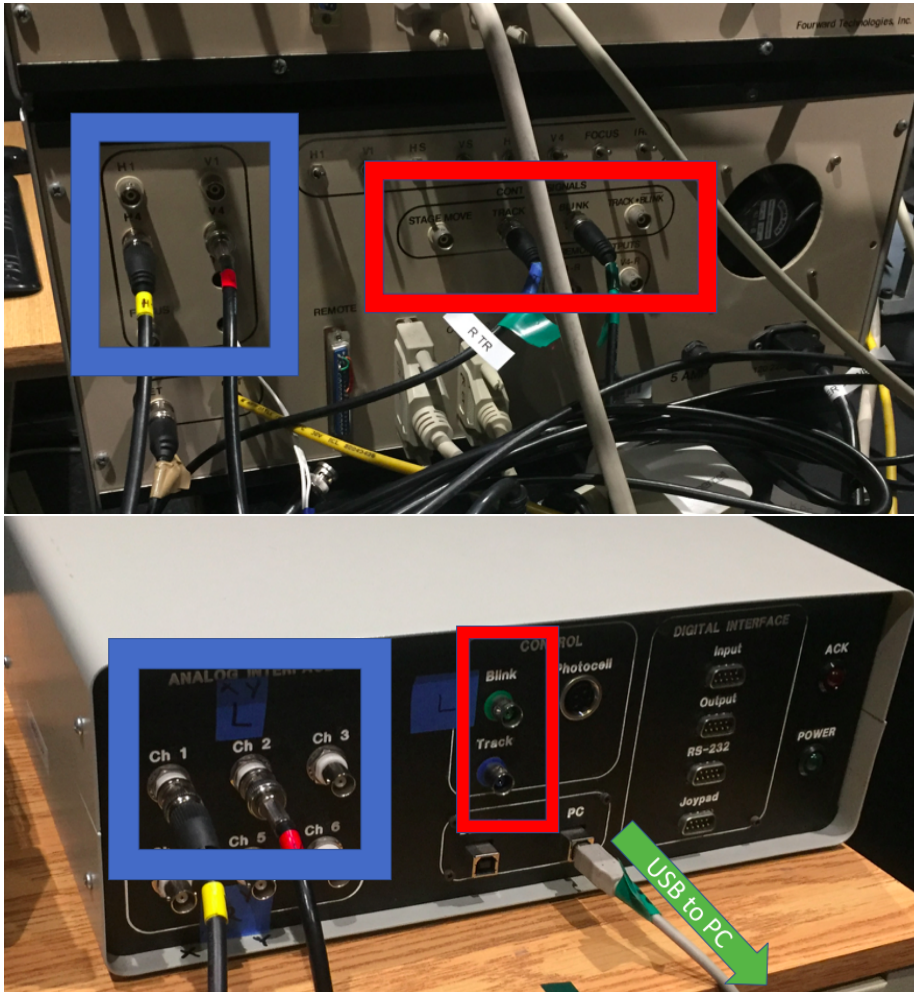


Figure 3: Back of the DPI (top) and front of the DSP (bottom). Horizontal and vertical eye traces (H4 and V4 on DPI) go to channels 1 and 2 respectively on the DSP.

5.2 Setting up artificial eye with galvo



Figure 4: Function generator (left) → galvo driver (right) → galvo with artificial eye (top). The galvo driver should be set with gain 1 and offset 3.5 (written on label). There are two power switches on the galvo driver - one on the front and one on the back to power the galvo. For basic instructions on how to operate the function generator visit the Tektronix manual (page 2-14).

6 Troubleshooting

6.1 Joypad

If the joypad isn't responding, try unplugging and replugging or restarting the DSP. This joypad seems to be a little glitchy with the binocular DSP and occasionally extra buttons seem to be pressed.

6.2 EMIL console error about specific display resolution

An error about setting the resolution of the display (for example to 800×600 200Hz) may occur after restarting the computer. To fix this:

- Right-click on the desktop and open **NVIDIA Control Panel**
- Under the **Display** menu, select **Change resolution**.
- Select the **Customize** button below the list of default Resolutions for the Idek Iiyama monitor.
- Select **Create Custom Resolution**.
- Set the desired horizontal and vertical resolutions and the refresh rate. Press **Test** and accept the settings by selecting **Yes** when prompted.
- Return to the **Change resolution** screen - you should now see your custom resolution at the top of the Resolution list under "Custom". You *do not* need to actually set the resolution here.

6.3 EMIL console: NVAPI_OK ERROR, Display exception

This is another error about using a custom resolution for the psychophysics monitor.

- Right-click on the desktop and open **NVIDIA Control Panel**.
- Under the **Display** menu, select **Change resolution**.
- Select the **Customize** button below the list of default Resolutions for the Idek Iiyama monitor.
- Make sure the box next to "Enable resolution not exposed by display" is checked.
- Apply and exit.

- If the error still comes up, change the refresh rate in the experiment's parameter file to 60Hz. This should be fine for testing the artificial eye but would need to be further investigated.