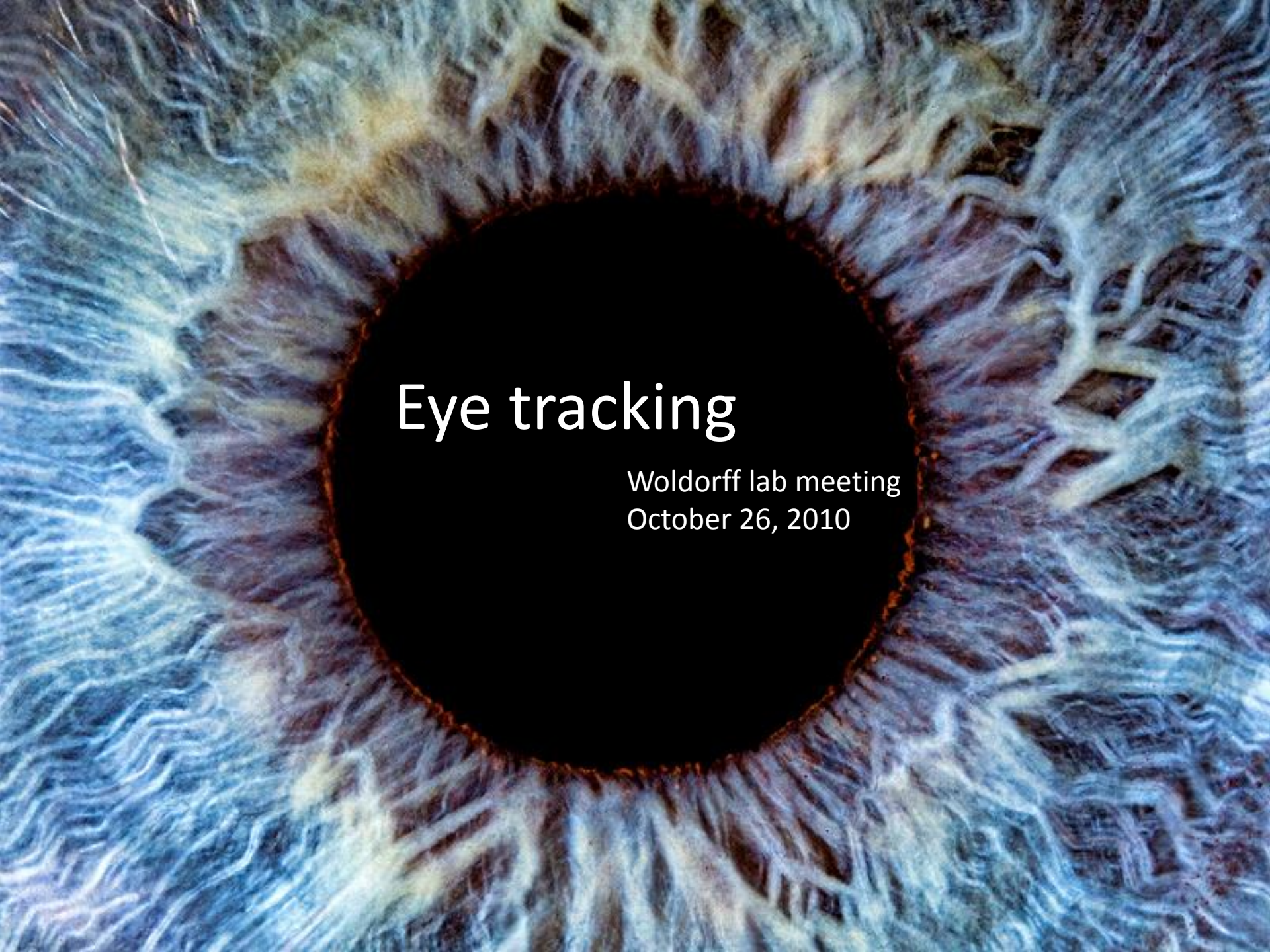


Eye tracking

Woldorff lab meeting
October 26, 2010

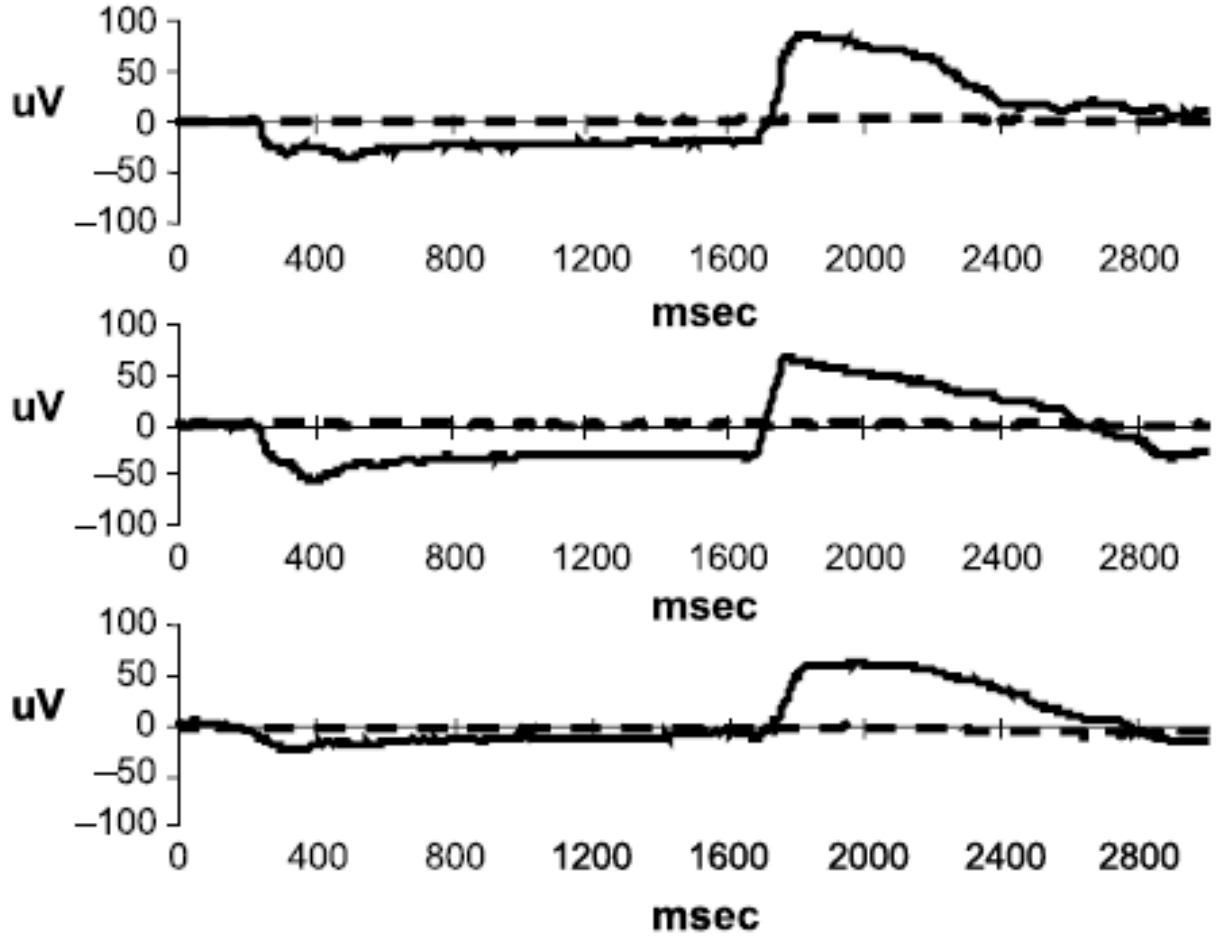
Reasons to use eye-tracking

- Ensure subject maintains fixation
  - Mean eye-position, std dev of eye-position
  - Time-locked average eye-trace to left-cue against right-cue
- Follow saccades to regions of interest (ROIs)
  - Calculate ROI dwell time
- Generate “heat maps”
- Generate “overlay traces”

Title photo: Gregory A. Dunbar

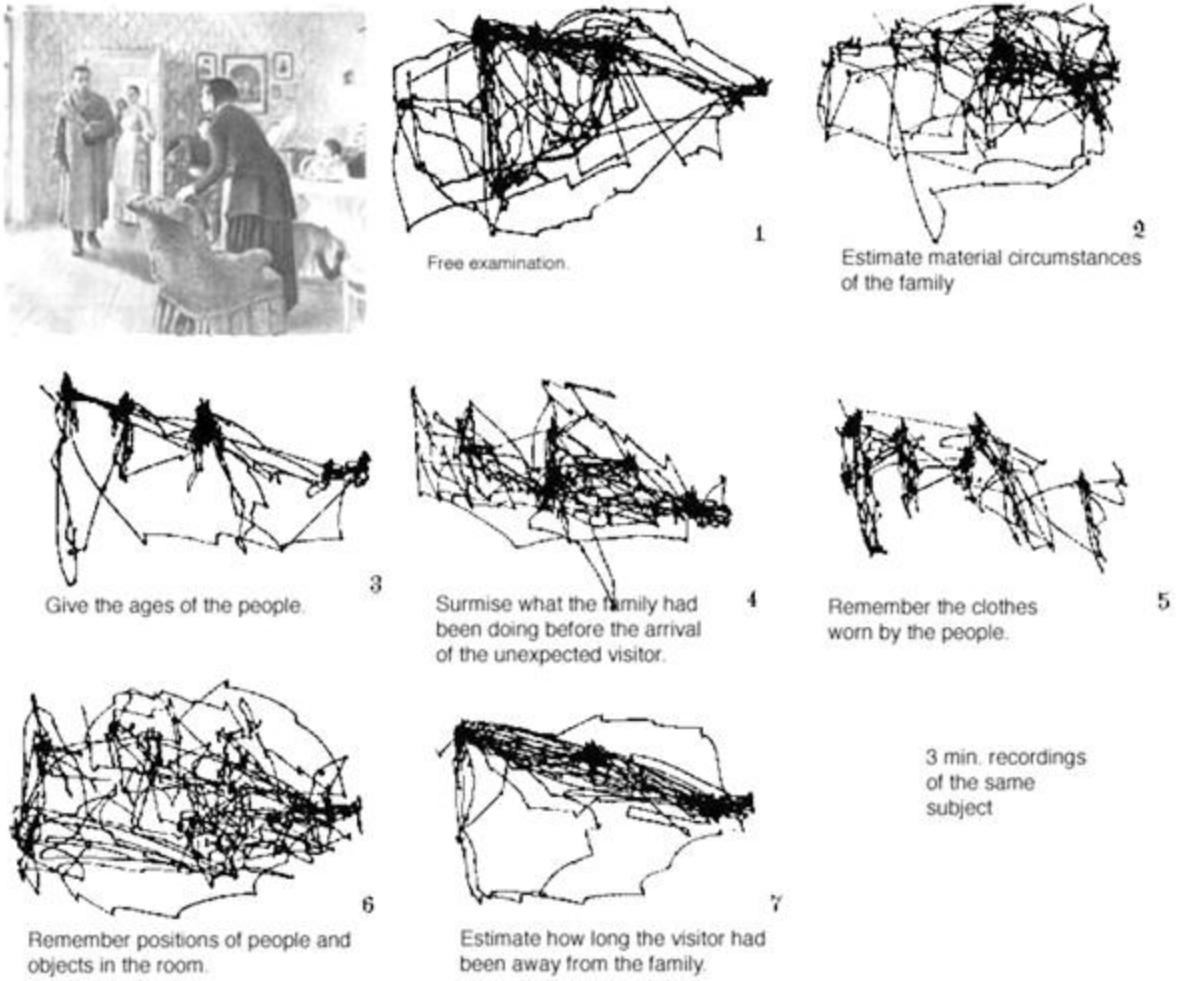
Planning covert shifts of attn.

EOG Data



Hazlett and Woldorff, 2004

Traces as a function of task

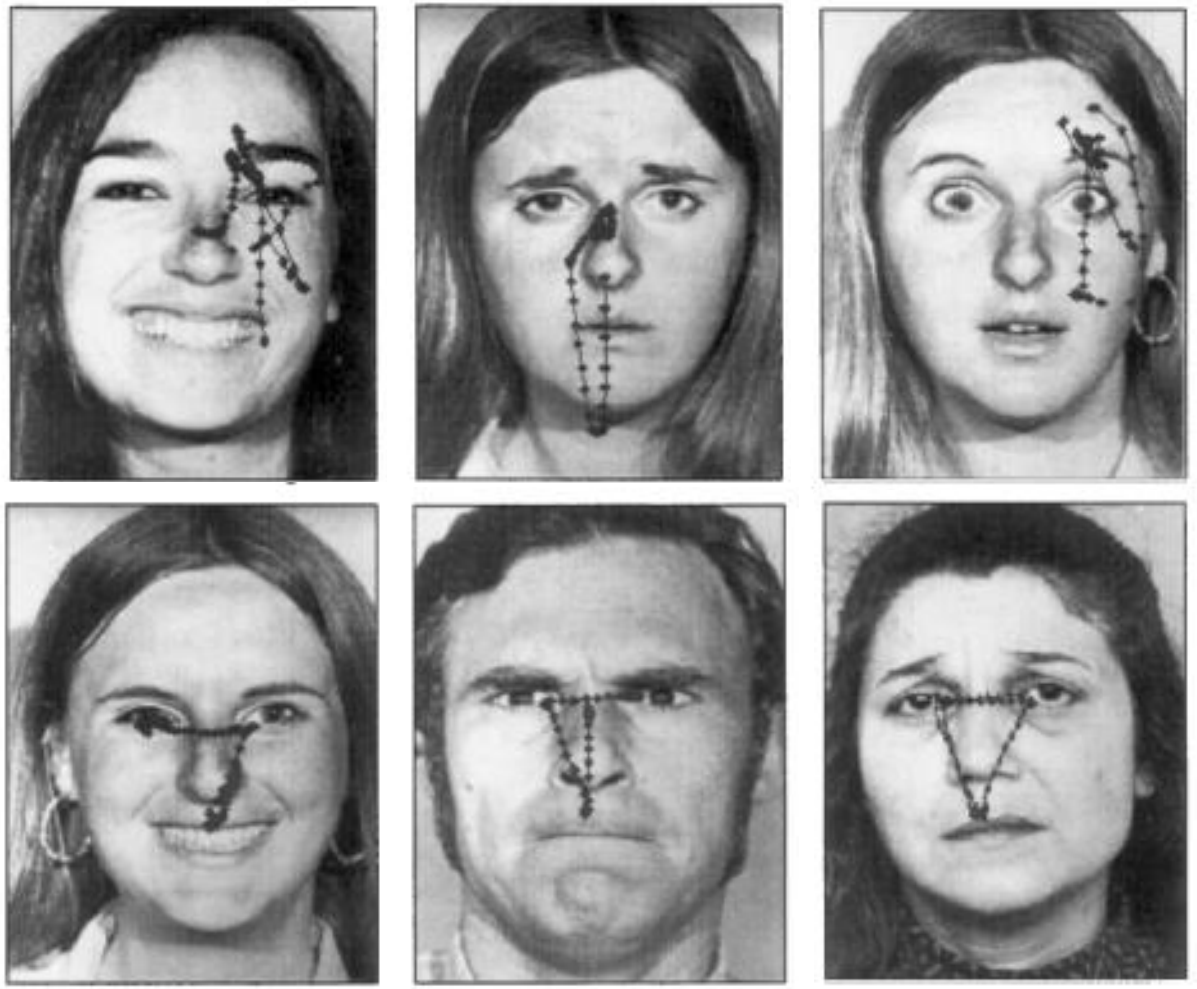


Yarbus, 1967

Visual processing and disorders

Face scanning
(autism group)

Face scanning
(control group)

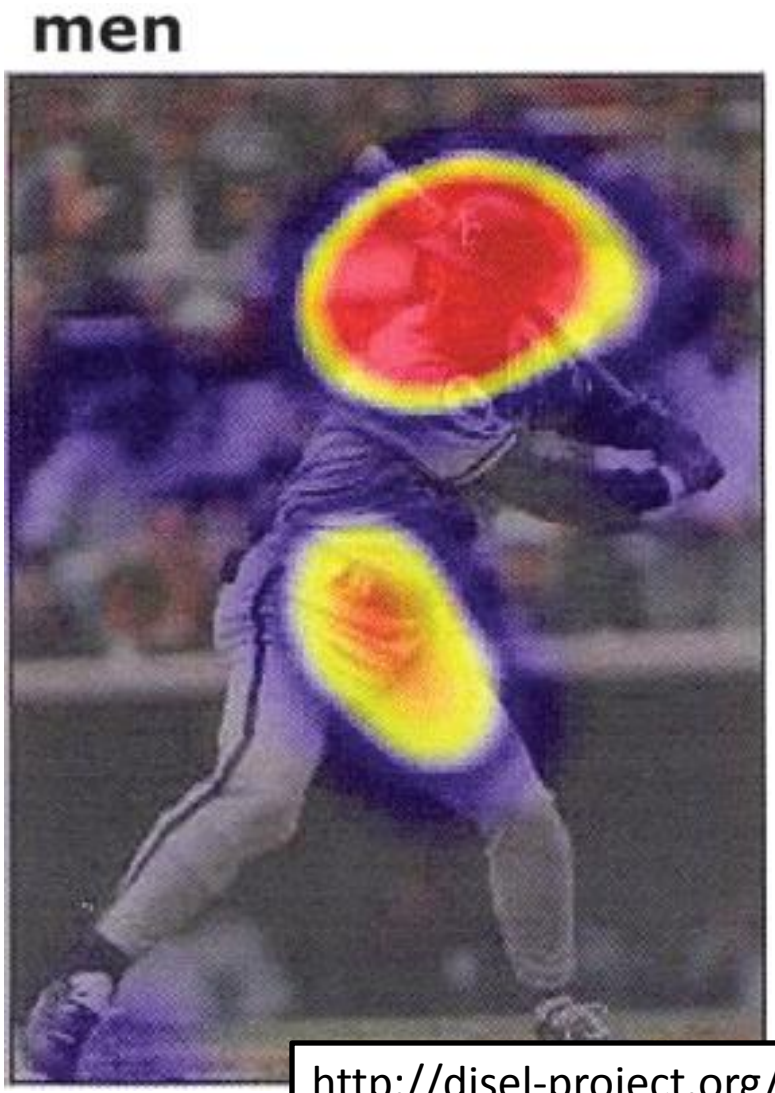


Pelphrey et al., 2002

Mapping salience

http://www.etre.com/usability/eyetracking/showme/

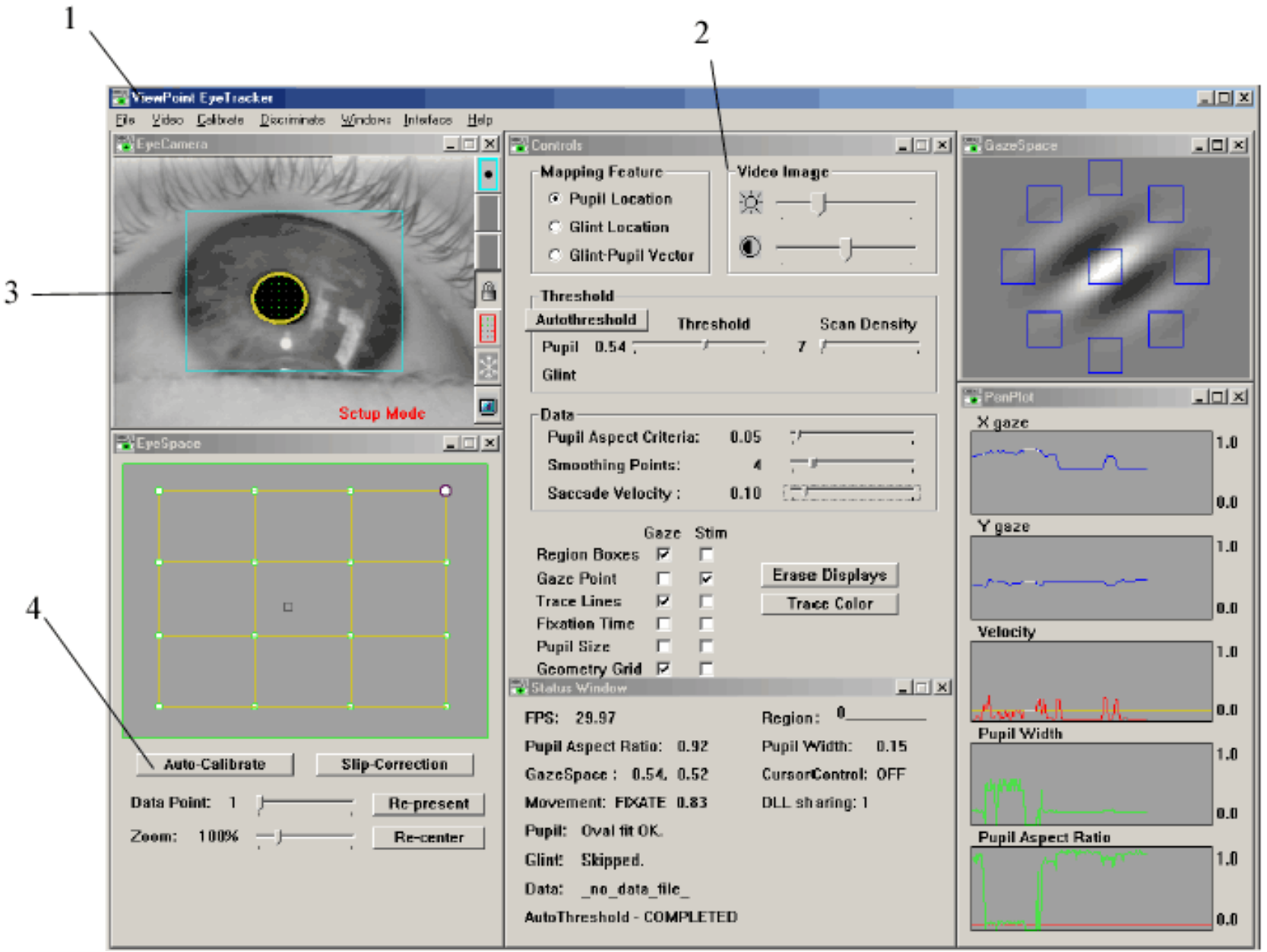
Biological salience



http://disel-project.org/

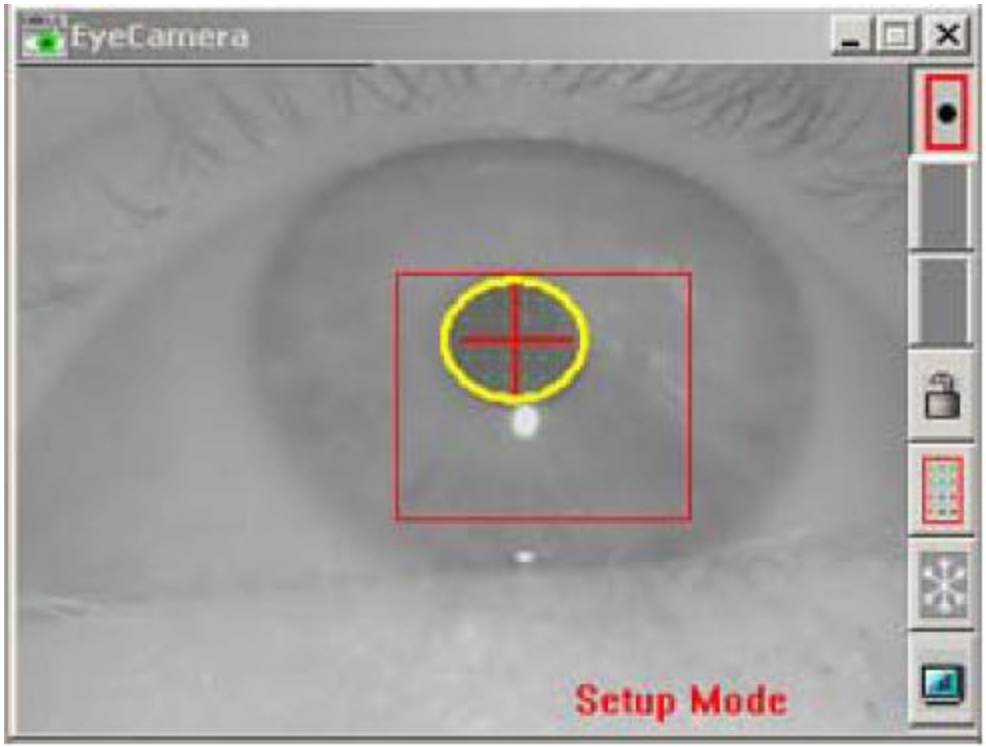
BIAC Eyetracking Equipment

- Camera w/IR LED illumination mounted to head-coil (30-60Hz scanning, adj.)
- NTSC signal (interlaced) sent to TV-capture board
- Viewpoint interface uses video signal to segment pupil and track its location
- After calibration, VP records location data to file.



http://fourier.biac.duke.edu/wiki/doku.php/biac:experimentalcontrol:eyetrackviewpoint

Step 1: get good pupil contrast



Pupil Search Area Adjustment

Lock Search Area Adjustments

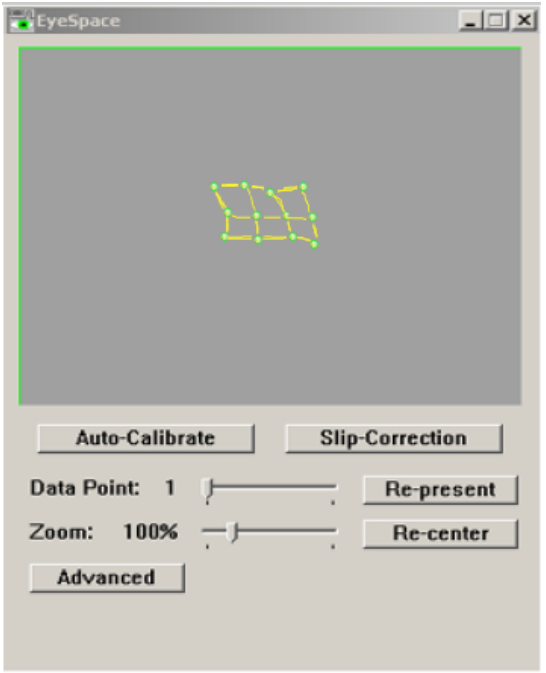
Toggle Show Threshold Dots

Freeze Video

Operation Mode Toggle

Make sure that the eye is well-centered in the visual field. This needs to be done before the subject is slid into the scanner, and the MR tech will help you with this part. Then, use the console to adjust the LED intensity if necessary.
Toggle “show threshold dots” and adjust “Brightness” and “Contrast” sliders to segment the pupil. Adjust bounding box to constrain search area.

Step 2: Calibrate well



Instruct subject on “following the blinking cues”. Warn subject that calibration is about to start. Do twice in a row so that subject is familiar with procedure. Ensure that the calibration matrix that comes out is regular-looking and not folded back upon itself. (example depicts a decent calibration). Try adjusting parameters of calibration routine.

REPEAT AS MANY TIMES AS NECESSARY UNTIL YOU ARE SATISFIED!!

Step 3:

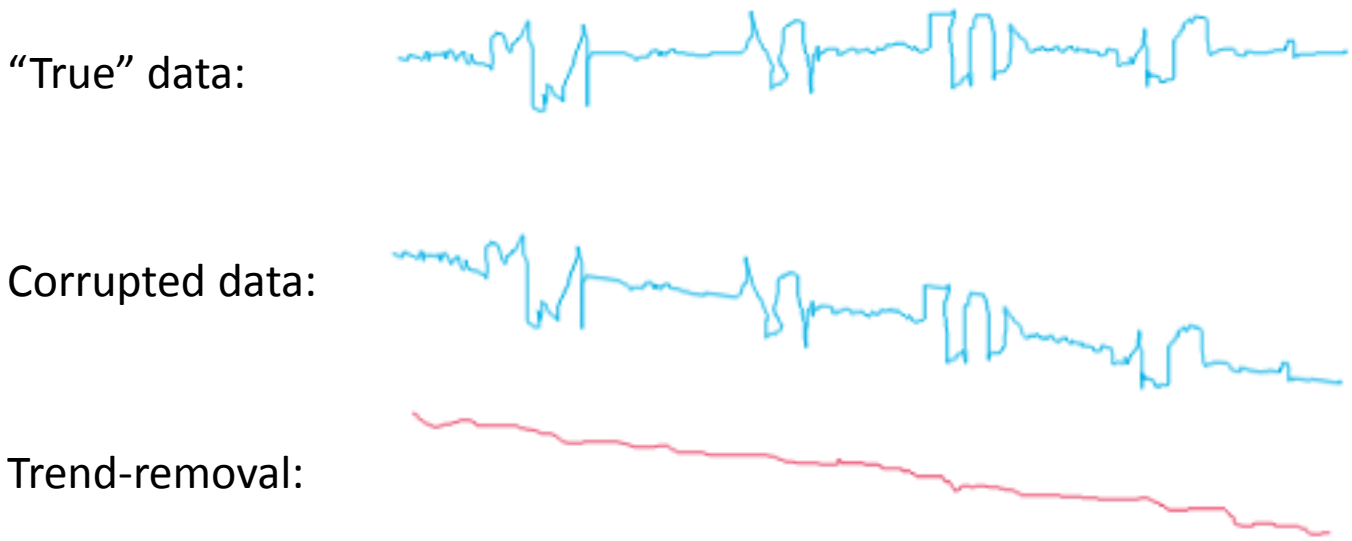
- Follow instructions on the BIAC wiki to get Presentation to communicate with Viewpoint so that stimulus events can be recorded in the eye-tracking datastream.
- Double-check timing, and be sure that you can keep both the Presentation and the Viewpoint logfiles in sync!
- Check logfile for markers after running
- Keep an eye on traces
- (this is harder than you might think)

Problems:

- Head movement throws off calibration
- Hard to double-check afterward, as the possibly-faulty coordinates are the only things recorded (and not the video signal).
- Not so great software
  - Crashy? Please record error message and give to me.
  - from BIAC talk, JV's calibration routines superior to VP's
  - (for $7K, frankly, I'm not impressed.)
- Positioning: only MR tech, fixed at too-great distance
- Not done with so much frequency.

Drift correction

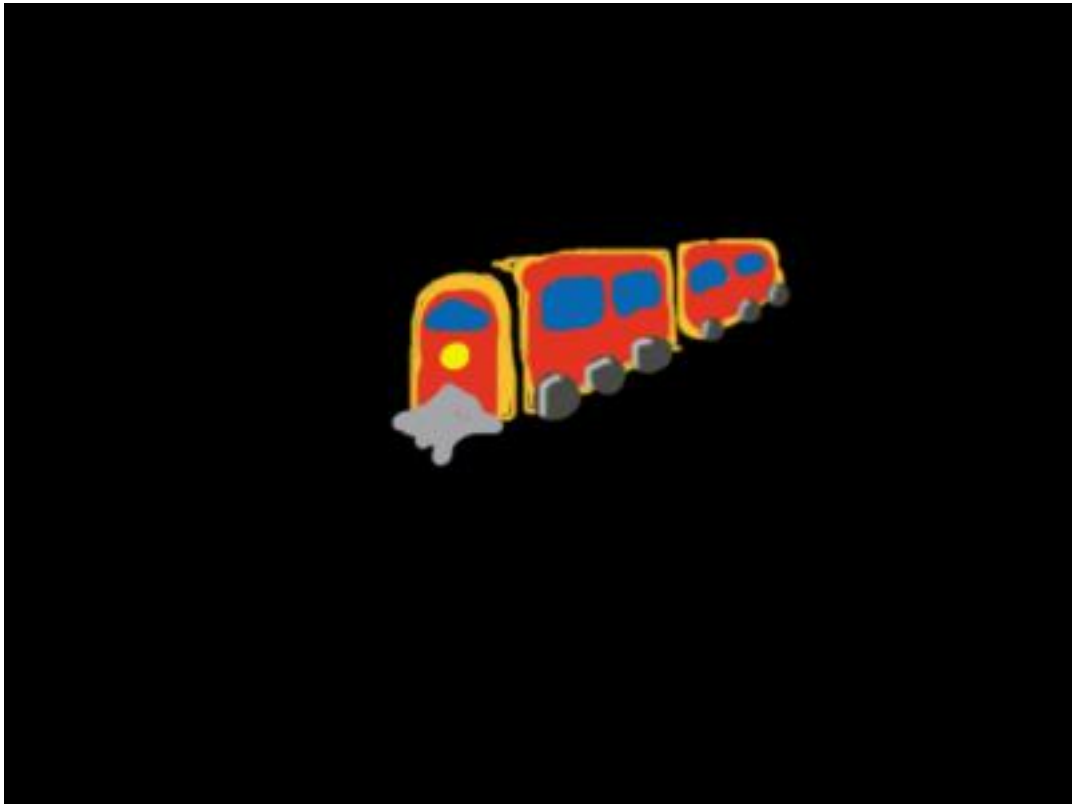
- Recalibrate every run?
- High-pass filter correction on y-coordinates?
- Adjust the calibration mtx at every fixation?



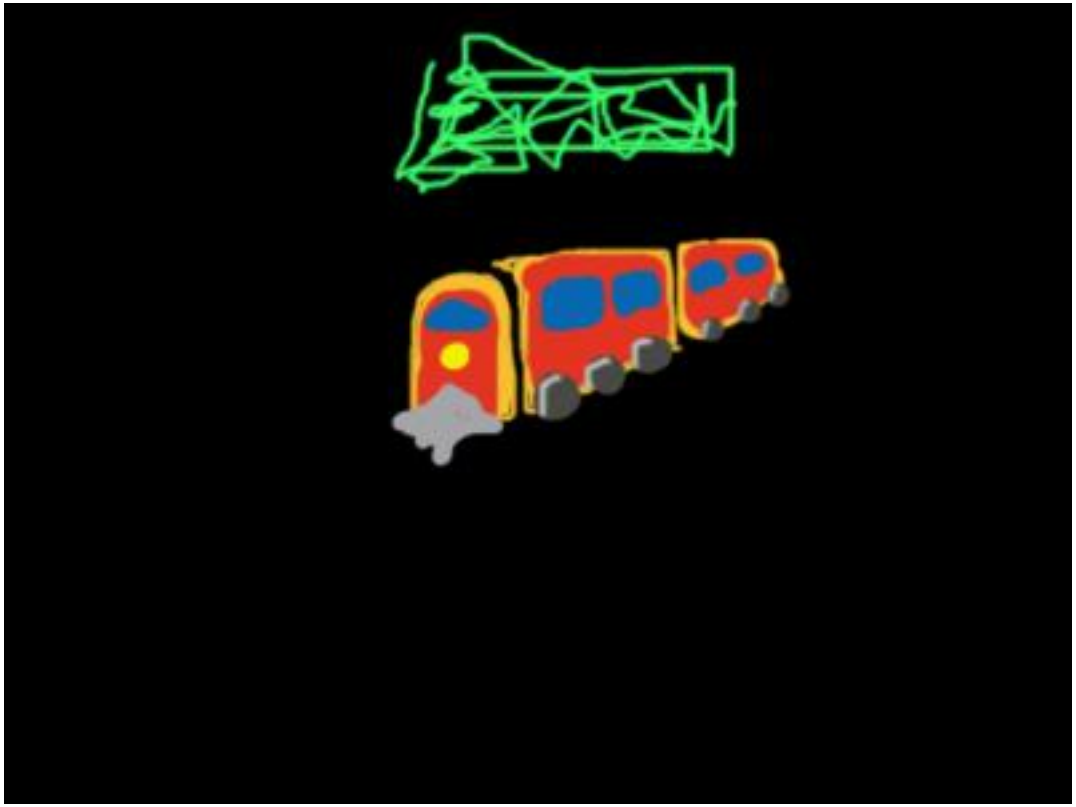
Software we have:

- Presentation + VP (codes to VP over serial)
  - Somewhat difficult, what we do now.
- CIGAL + VP (eye locs over serial to CIGAL)
  - Can do calib, replay traces on actual pdigm, display horz+vert displacement w/physiological data and MR trigs
- Presentation + VP-Pres Addon + VP
  - Easy integration w/ presentation, not installed yet
- Chris Petty's script for ROI analysis, bxh_events
- Ken's scripts for quick MATLAB analysis (unfinished)

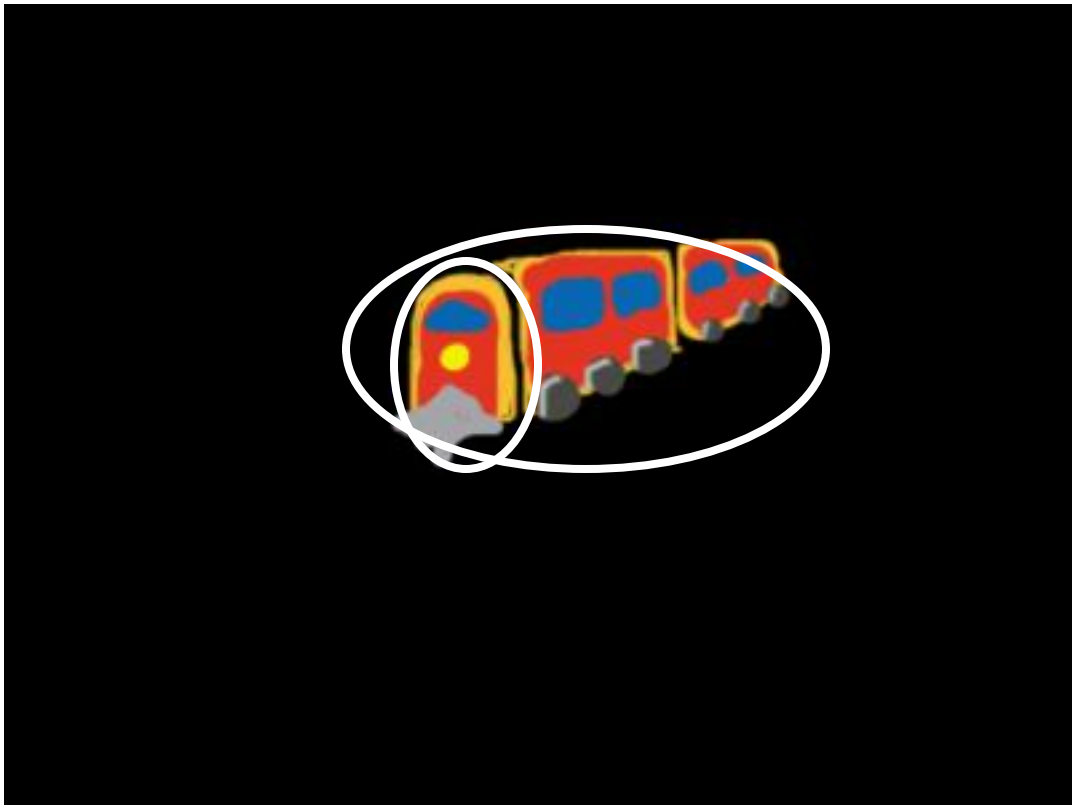
CIGAL Replay



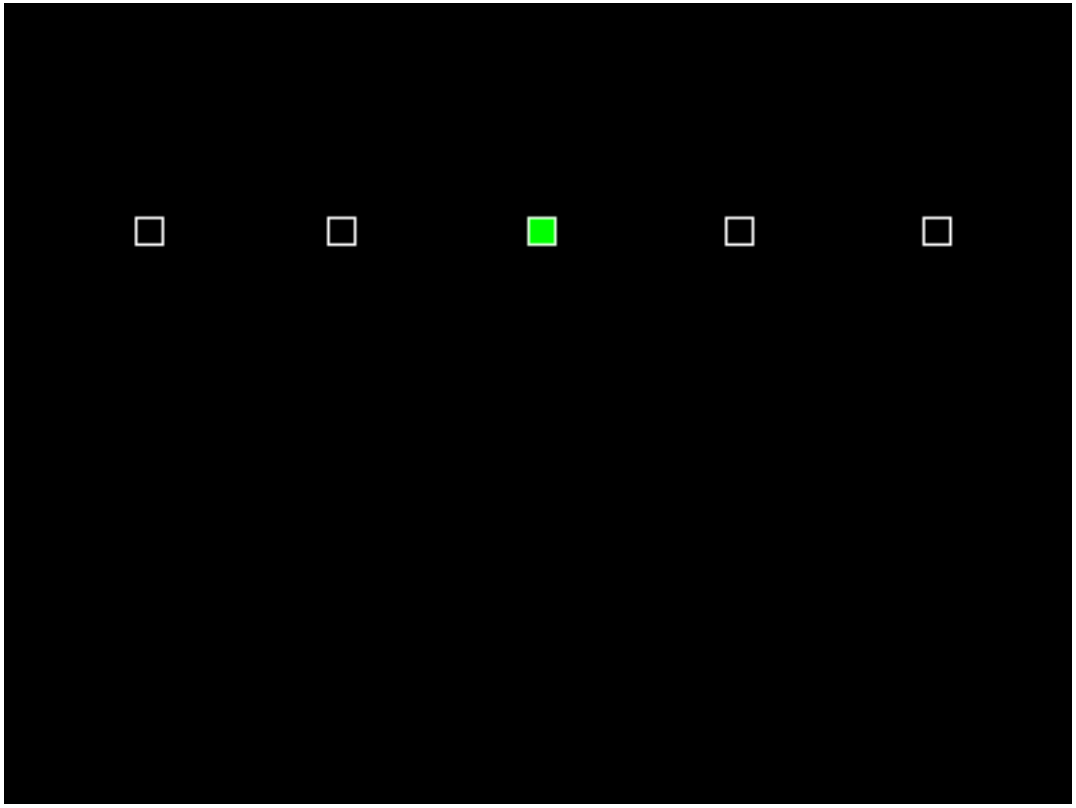
CIGAL Replay



Define an ROI (Chris P.)



Ruth's SaccAtt Experiment



Viewpoint logfile (txt or xls)

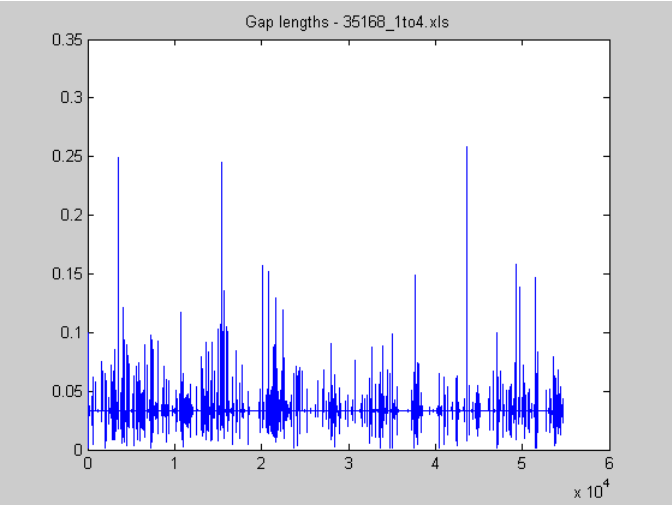
	A	B	C	D	E	F	G	H	I	J
1	3	Product Version: PC60								
2	3	Executable File Version: 2.6.1								
3	3	Program Build Date: Aug 13 2002, 20:41:02								
4	3	Serial Number: 200-326-2-2								
5	3	Customer Name: Jim Voyvodic, Duke University, NC								
6	3	----------								
7	3	TimeValue	2008	10	23	14	4	56	UTC	
8	3	TimeStam	Thursday, October 23, 2008, 10:04:56 AM							
9	3	DataForma	57							
10	3	----------								
11	3	TotalTime	DeltaTime	X_Gaze	Y_Gaze	Region	PupilWidth	PupilAspe	Count	Torsion
12	2	0	+							
13	10	0.0147	0	0.4735	0.484	0	0.1562	0.9615	0	-998
14	10	0.048	33.263	0.4709	0.3515	-1	0.1625	1	1	-998
15	10	0.0815	33.492	0.4709	0.3515	-1	0.1562	0.9259	2	-998
16	10	0.1147	33.22	0.4529	0.3216	-1	0.1594	0.9273	3	-998
17	10	0.148	33.351	0.4691	0.2876	-1	0.1562	0.9259	4	-998
18	10	0.1815	33.418	0.4358	0.324	-1	0.1625	0.9811	5	-998
19	10	0.2143	32.886	0.4538	0.3538	-1	0.1594	0.9444	6	-998
20	10	0.248	33.679	0.4717	0.384	-1	0.1562	0.9091	7	-998

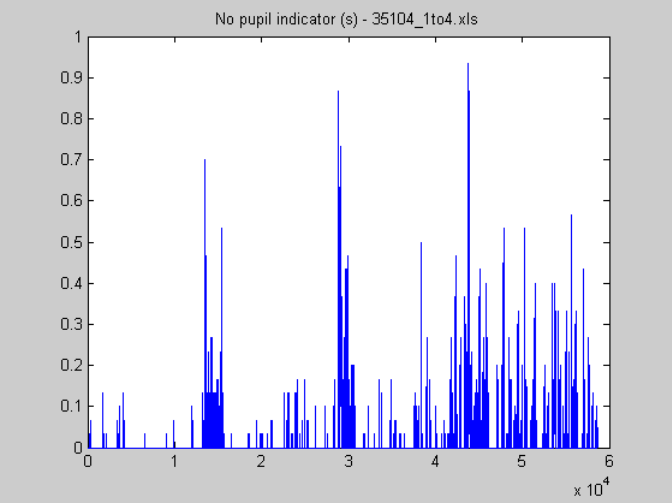
Lost pupil and markers

42302	10	1398.509	33.702	1.8685	-0.6242	-1	0.0312	0.8	41117	-998
42303	99	1398.541	3	0						
42304	10	1398.575	66.441	2.2421	-0.5407	-1	0.0406	0.6154	41118	-998
42305	10	1398.608	33.212	0.4306	-0.0864	-1	0.0969	0.6129	41119	-998
42306	10	1398.642	33.446	1.7151	-0.5053	-1	0.0094	0.3333	41120	-998
42307	10	1398.675	33.346	1.875	-0.254	-1	0.0281	0.1111	41121	-998
42308	99	1398.708	3	0						
42309	99	1398.741	3	0						
42310	99	1398.775	3	0						

42534	10	1406.205	33.518	1.0986	0.1939	-1	0.1969	0.8095	41322	-998
42535	12	1406.221	1							
42536	10	1406.238	33.125	1.1551	0.1905	-1	0.2125	0.75	41323	-998
42537	10	1406.272	33.617	0.7679	0.2526	-1	0.1469	0.9038	41324	-998

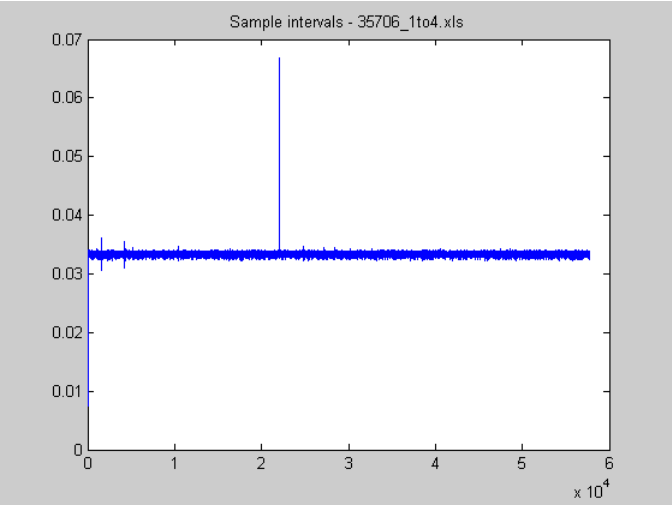
est_quality

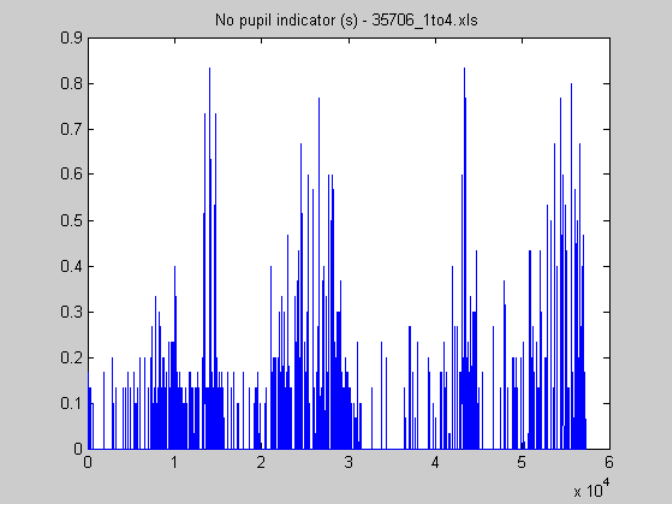





```
Quality information for file: 35104_1to4.xls
    Number of points:                58007
    Points with 'no data':           1514
    Glitches:                        2
    Events:                          567
    Gaps > two samples:              90
    Percent <0 and >1:
         x:                              3.48,      5.34
         y:                              0.87,     39.51
    Percent <-0.5 and >1.5:
         x:                              0.37,      1.30
         y:                              0.10,     12.53
```

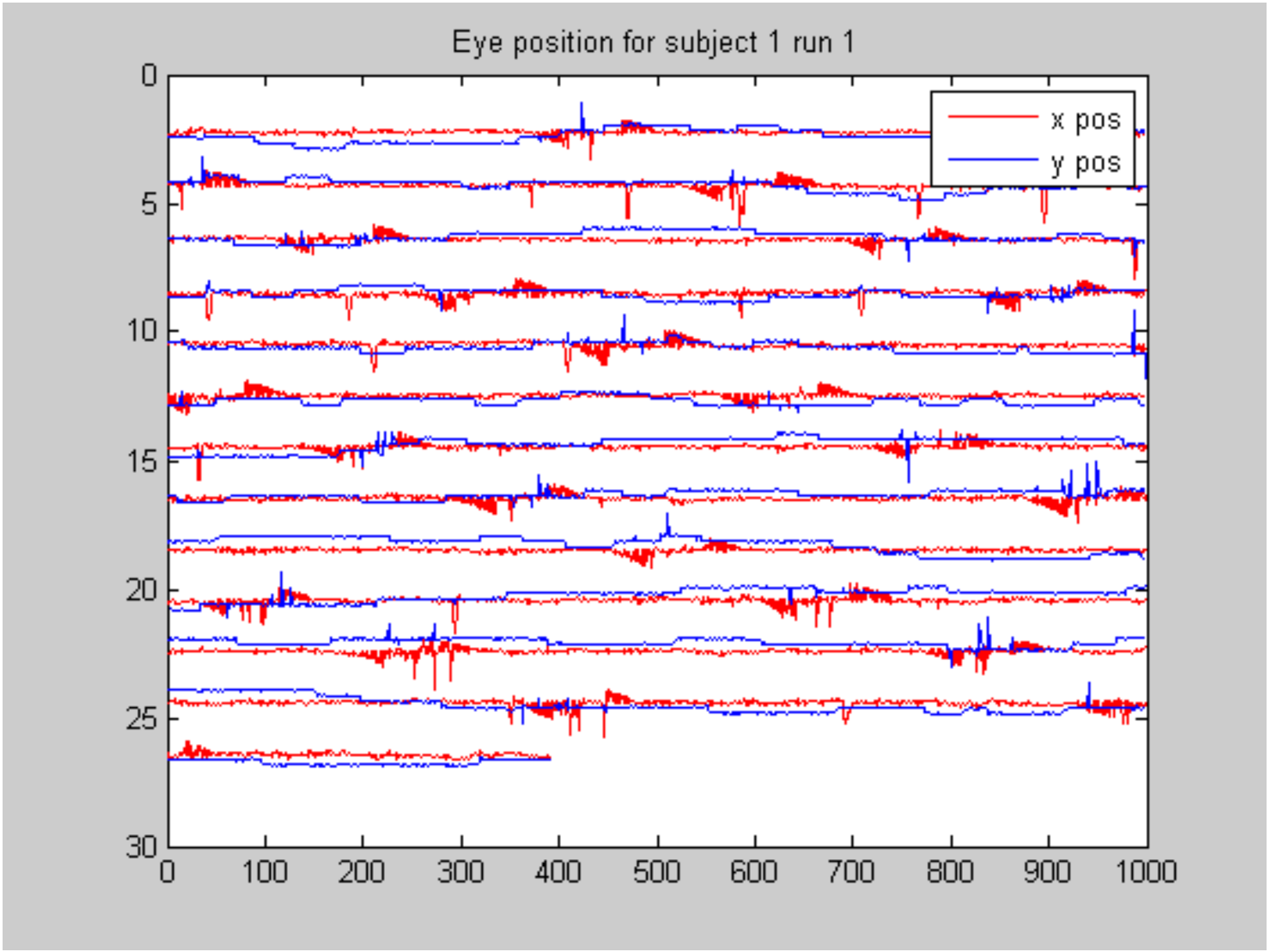
est_quality



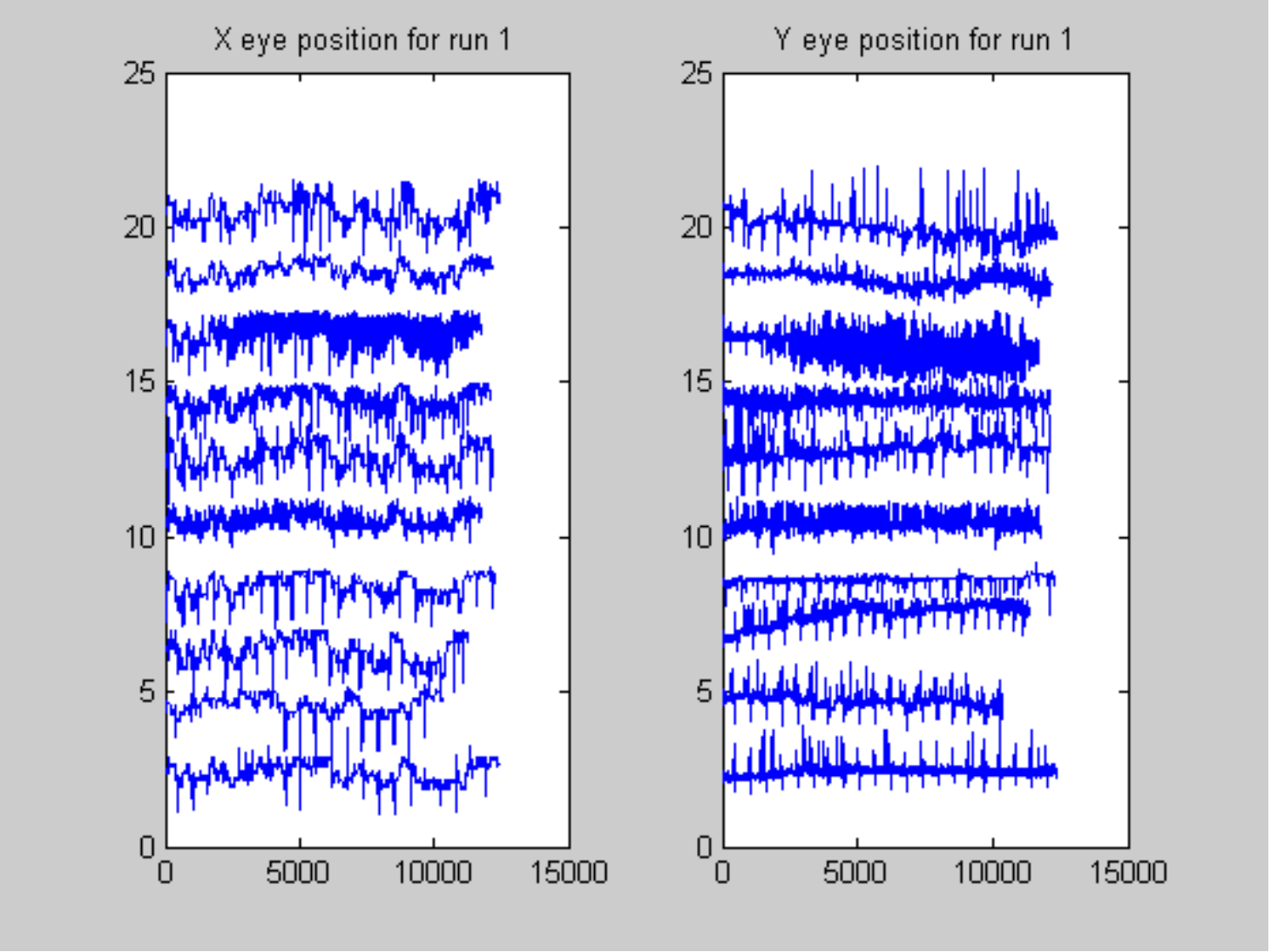



```
Quality information for file: 35706_1to4.xls
    Number of points:              57780
    Points with 'no data':         238
    Glitches:                      1
    Events:                        563
    Sample intervals > 2*period:   1
    Percent <0 and >1:
         x:                          15.98,     10.84
         y:                          46.49,      7.90
    Percent <-0.5 and >1.5:
         x:                           3.16,      0.06
         y:                           6.68,      5.26
```

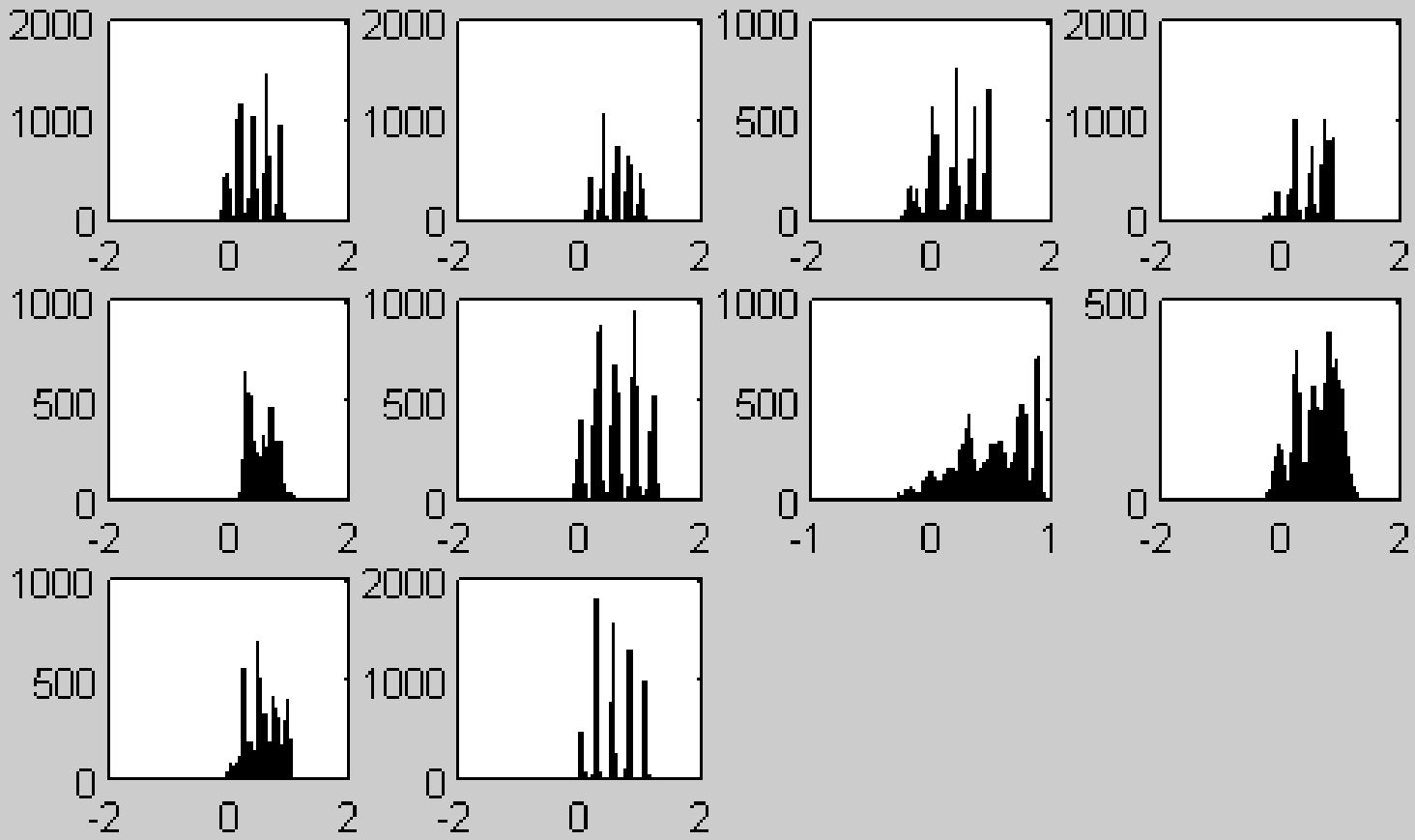
plot_trace


Eye position for subject 1 run 1
x pos
y pos
0
5
10
15
20
25
30
0
100
200
300
400
500
600
700
800
900
1000

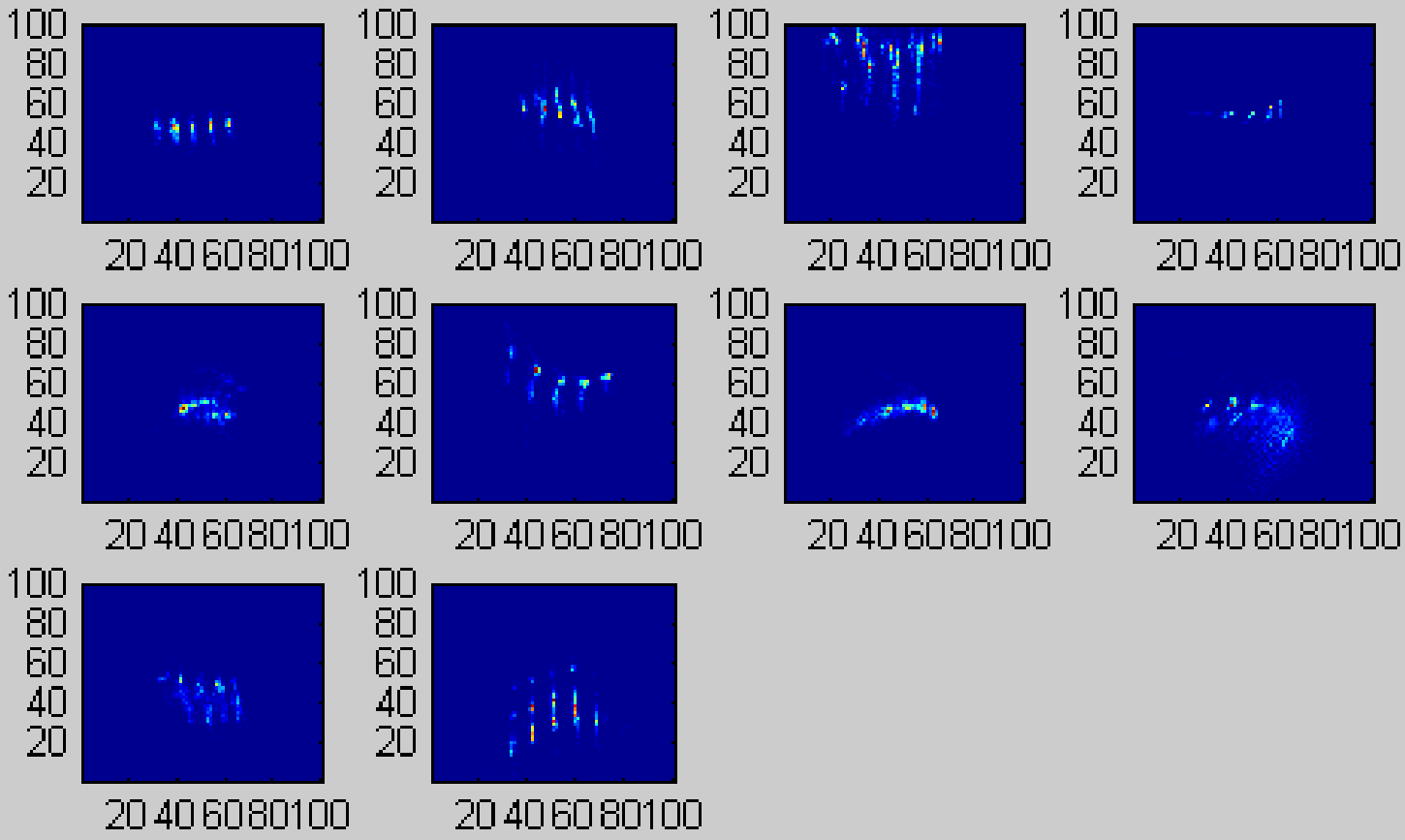
plot_traces


X eye position for run 1
Y eye position for run 1
25
20
15
10
5
0
0
5000
10000
15000

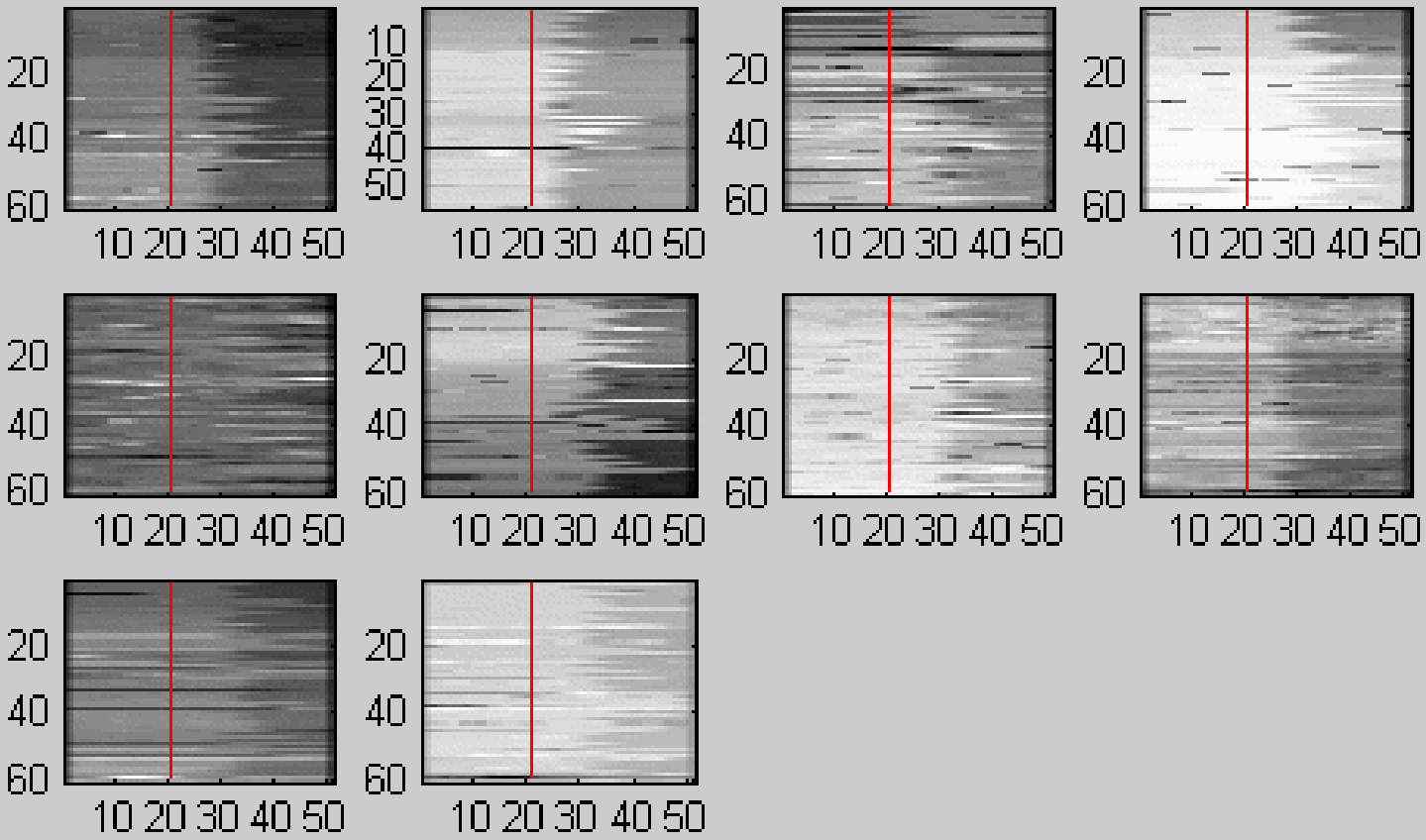
plot_x_histograms



plot_joint_histograms



Make_pst


20
40
60
10 20 30 40 50
10
20
30
40
50
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50
20
40
60
10 20 30 40 50

Make_pst