Commentary on the Analysis of the HumanFixationEvaluation Dataset in the gazeNet Paper: *gazeNet*: End-to-end eye-movement event detection with deep neural networks (Zemblys, Niehorster, and Holmqvist, 2019)

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1 Introduction

In the gazeNet paper [1], several automatic classification schemes were evaluated and compared on the on the humanFixationEvaluation dataset made available by [2] [1] This report makes the case that this particular use of this dataset is highly problematic.

2 Statements in gazeNet paper about the humanFixationEvaluation dataset

Let us begin by citing the statements made in the gazeNet paper [1] on the humanFixationEvaluation dataset:

> "...humanFixationEvaluation [3] containing data from [4]" (Page 16)

> "The humanFixationEvaluation dataset [4, 2] was collected with a Tobii TX300 (300Hz) eye-tracker and derived from infant and adult participants. The total of almost 6 minutes of data were then hand labeled by 12 expert coders, who were asked to label only fixations. Because of the relatively small size of the dataset, we used the labels from all 12 coders in our evaluation." (Page 16)

> "In the case of humanFixationEvaluation dataset, the samples that were left uncoded were artificially set to saccade samples and only originally missing samples were considered as missing when evaluating the algorithms." (Page 16)

> "In particular this is evident for the humanFixationEvaluation dataset, where both the MNH and the NH2010 algorithms perform approximately twice as bad than IRF and gazeNet." (Page 17)

> "Hooge et al. (2017) report that the average noise level in this dataset is 0.32 - 0.36 degrees RMS, which means it has a 10x larger noise than in the lund2013-image-test (see Table 4). Neither MNH nor NH2010 are able to cope with such noise, while both machine learning approaches seem to perform reasonably well (probably because they have seen data with such noise levels during training)." (Page 17-18)

> "Moreover, the evaluation of gazeNet on two other datasets, GazeCom and humanFixationClasification, showed that gazeNet is not only able to generalize to unseen data with other qualities, but also agreed more with the hand-coding provided in these datasets than the other event detection algorithms." (Page 19)

[1] Made available by the authors at https://github.com/dcnieho/humanFixationClassification.

3 The humanFixationClasification dataset

In the humanFixationClasification [2], recordings were available from 10 adults and 60 infants. The sampling rate was 300 Hz. On average, 4,500 samples (approx. 15 sec) were recorded for each adult. On average, 1010 samples (approx. 3.33 sec) were recorded from each infant.

The dataset was rated by a number of different raters. All of the analyses presented herein were performed with only a single rater ('MN', Marcus Nyström). Dr. Nyström is a generally recognized expert in the classification of eye movements.

4 The Problem of "blink-saccades"

When a subject blinks, VOG-based eye trackers cannot measure eye position and often return a NaN value. Often, surrounding blink artifact, there are periods of data during which the eye-tracker can detect a signal, even though this periblink signal is not from an eye movement. The signals seen just before and after a blink can appear "saccade-like", and are often referred to as "blink-saccades". But these events are not saccades.

Recall that the gazeNet authors state: "In the case of humanFixationEvaluation dataset, the samples that were left uncoded were artificially set to saccade samples and only originally missing samples were considered as missing when evaluating the algorithms."

The gazeNet paper, according to their own description of their approach, would consider these events, which are either preceded or followed by NaNs, as "saccades". **see Figure 1**.

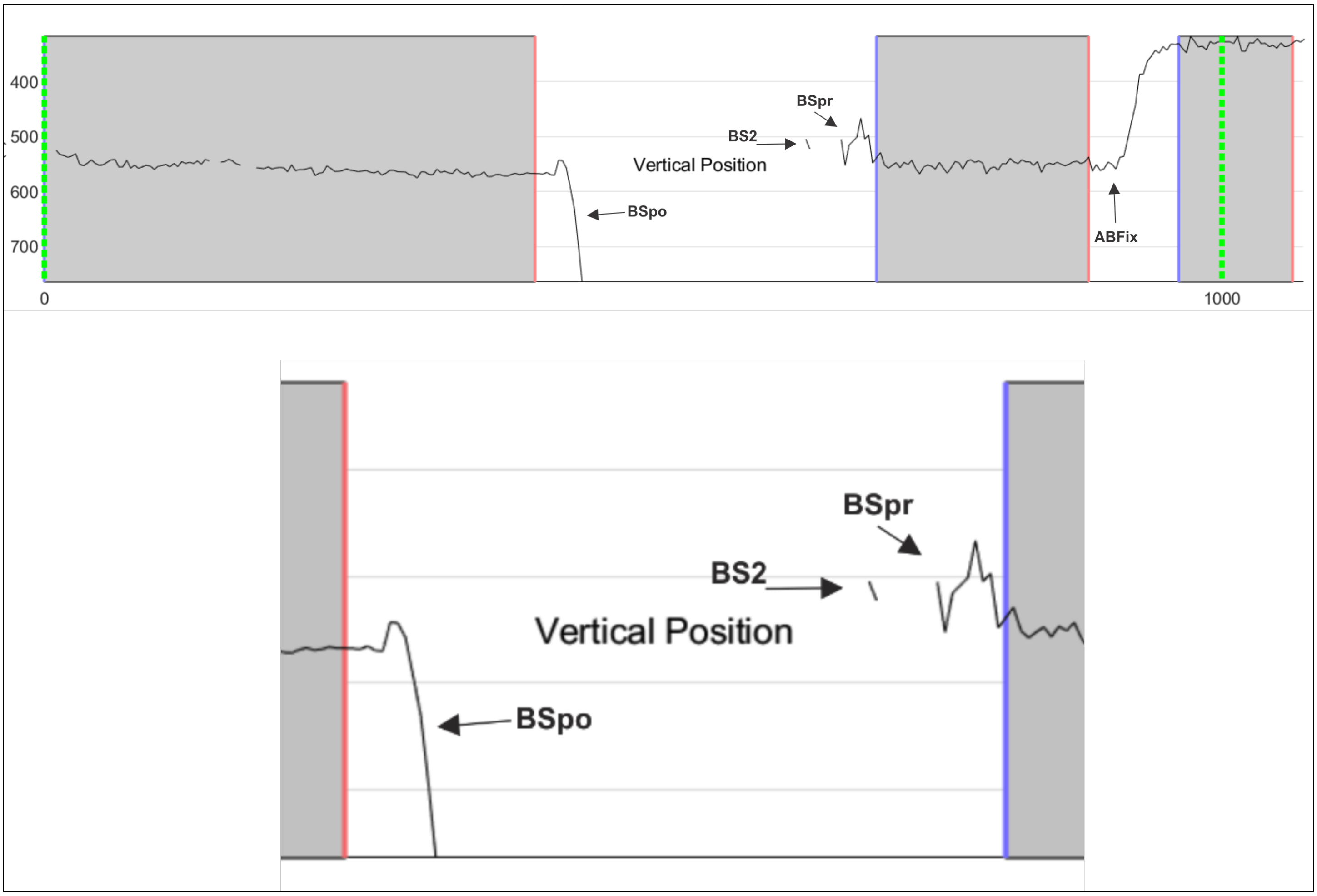

Figure 1: Illustration of the problem of blink-saccades for the gazeNet approach to the humanFixationEvaluation dataset. **TOP:** This is the vertical position signal from the 11^{th} infant study (infant-4592207091392917904). The gray sections are the portions of the data classified as fixation by rater MN. The arrows point to different types of blink-saccades. **BSpo** is a blink-saccade that is followed by NaNs. **BSpre** is a blink-saccade that is preceded by NaNs. **BS2** is a blink-saccade that is both preceded and followed by NaNs. **ABFix** is an event that is both after and before fixation periods. **Bottom:** A magnified version of the top of the figure.

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Using fixations marked only by rater MN, there are 929 defined "potential saccades" in the humanFixationEvaluation dataset as processed by gazeNet. Of these, 130 were both preceded and followed by NaNs, 106 were followed by NaNs and and 96 were preceded by NaNs. Therefore, there were 332 or 36% of potential saccades that were actually blink-saccades and not saccades.

5 The Problem of Non-Blink-Saccades that are Ill Formed

Of the 597 events that were not blink-saccades, there were a number of potential saccades that had very non-saccade-like trajectories. To detect such events automatically we followed the steps in Algorithm 1[2].

Algorithm 1: Steps in to Identify Poorly Formed Events treated as if they were Saccades by the gazeNet Authors

1. Determine the instantaneous velocity ($x_t - x_{t-1}$) of the horizontal and vertical position signals (Vel_x, Vel_y).
2. Compute the radial velocity (Vel_{rad}) as $\sqrt{Vel_x + Vel_y}$.
3. Integrate the radial velocity to estimate a eye-position radial saccade from the data. (**Figure 2B**)
4. Use [5] to estimate the form of a theoretical saccade by equation, using the time and amplitude of the radial saccade. .
5. Zscore transform both the radial saccade and the theoretical saccade.
6. Subtract the radial saccade position values from the theoretical saccade position values and save them as residuals.
7. Sum the absolute value of the residuals and divide by the number of samples to get a Residual-Per-Sample metric for each potential saccade.
8. Sort potential saccades (not blink-saccades) by their Residual-Per-Sample metric.
9. Illustrate some well formed and poorly formed good saccades found in this way (**Figures 2 and 3**).
10. Illustrate 162 of the most poorly formed of these potential saccade events. (**Figures 4-30**).

[2] The code for estimating theoretical saccade trajectories used below is at: https://www.mathworks.com/matlabcentral/fileexchange/62880-saccade-model-a-parametric-model-for-saccadic-eye-movement

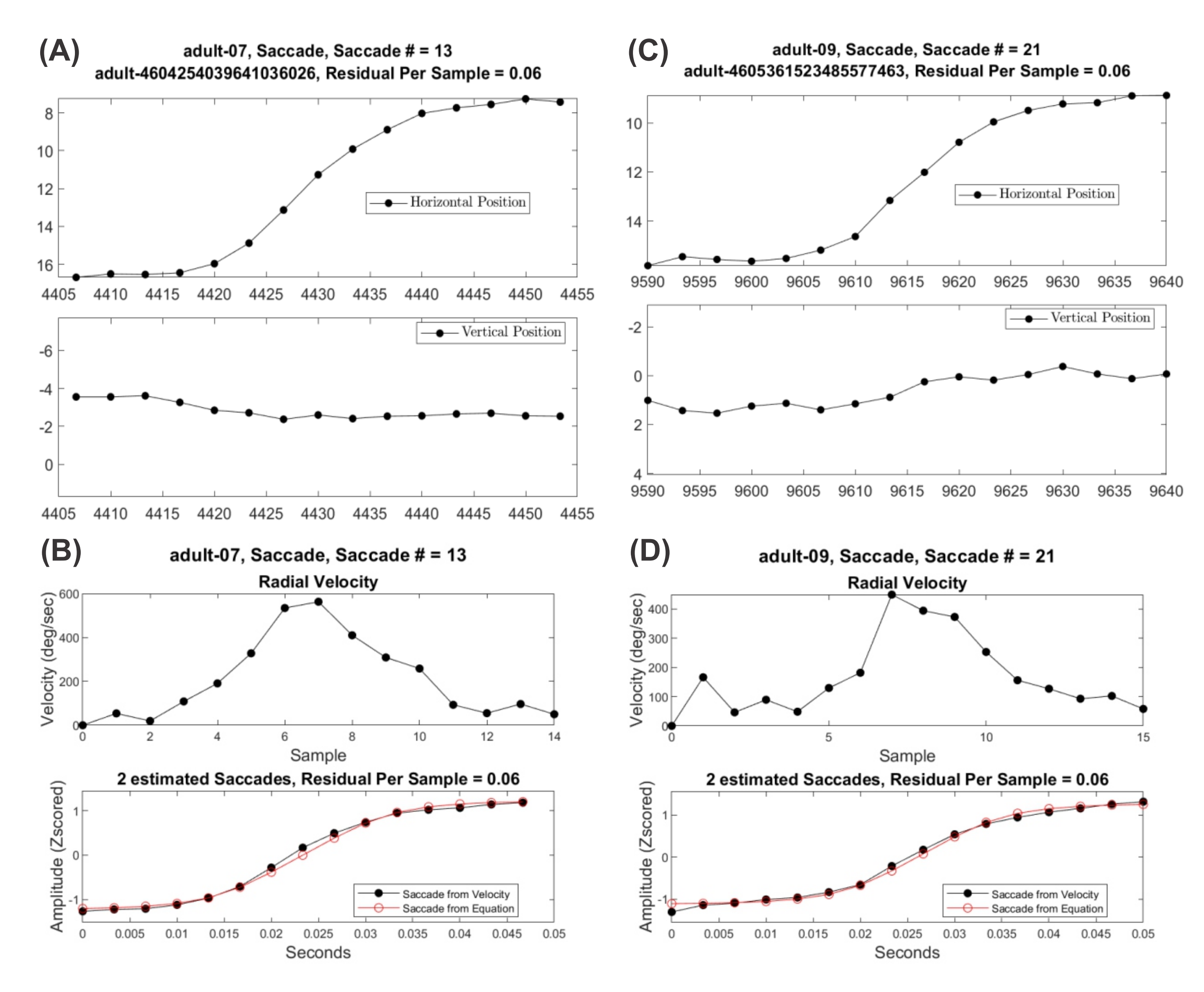


Figure 2: Detection of a Well-Formed Saccades. **(A)** The horizontal position and vertical position of an event considered as a saccade in the gazeNet processing of the humanFixationEvaluation dataset. The saccade is from the 7th adult recording. The low residual per sample (0.06) indicates that this is a well shaped saccade. **(B)** Illustrates steps in the process of determining if the event trajectory is consistent with a saccade (see Algorithm 1). Analysis pertains to saccade shown in **A**. **Upper Panel:** Radial velocity of the saccade. **Lower Panel:** Saccade trajectory constructed from integrating the velocity signal, and a trajectory from the saccade equation provided by [5]. **(C,D)** Saccade from the 9th adult recording. See **(A,B)** for details.

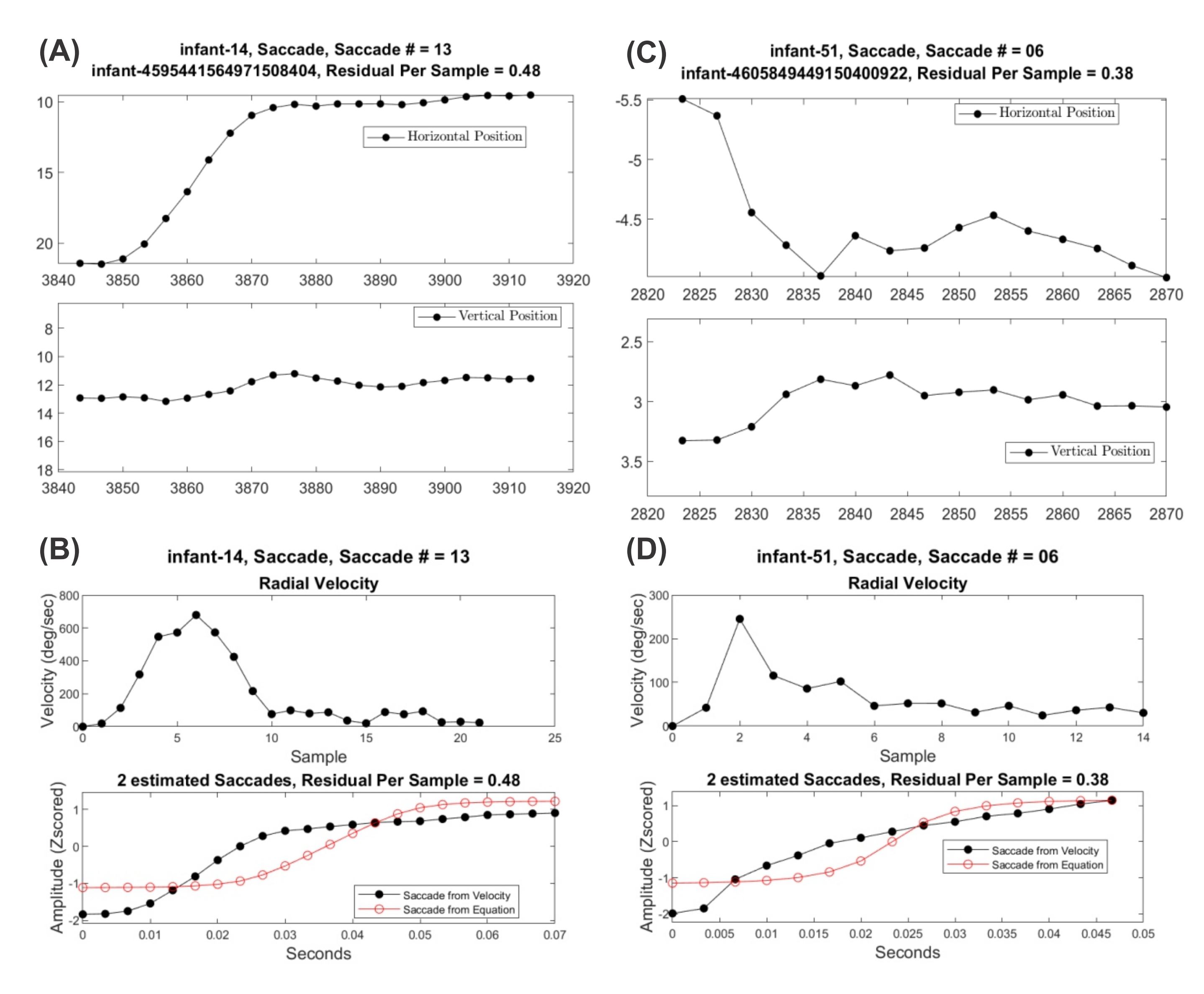


Figure 3: Detection of Poorly-Formed Saccades. **(A)** The horizontal position and vertical position of an event considered as a saccade in the gazeNet processing of the humanFixationEvaluation dataset. The saccade is from the 14th infant recording. The high residual per sample (0.48) indicates that this is a poorly shaped saccade. See caption for Figure **2** for details. **(C,D)** Data from the data from the 51st infant recording.

6 Unusual Potential Saccade Trajectories

What follows are 27 figures **Figures 4-30** illustrating unusual potential saccade trajectories. Each page contains 6 potential saccades. The 162 potential saccades are presented in descending order of the Residual-Per-Sample metric. Saccades with lower Residual-Per-Sample values than 0.24 started to look more acceptable and so the presentation stopped there.

The **Discussion** section follows the presentation of these 162 potential saccades.

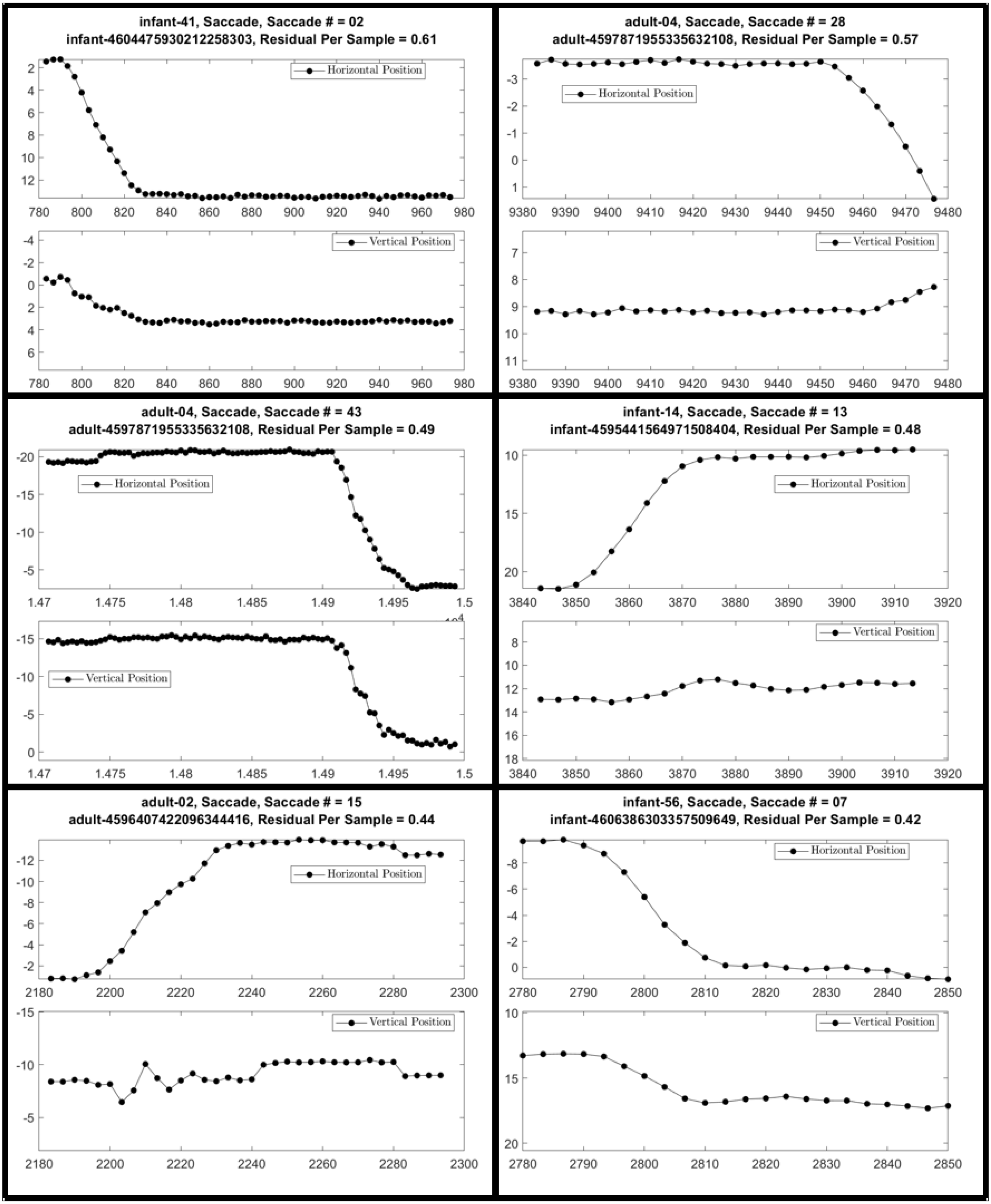

infant-41, Saccade, Saccade # = 02
infant-4604475930212258303, Residual Per Sample = 0.61
Horizontal Position
2
4
6
8
10
12
780
800
820
840
860
880
900
920
940
960
980
Vertical Position
-4
-2
0
2
4
6
adult-04, Saccade, Saccade # = 28
adult-4597871955335632108, Residual Per Sample = 0.57
Horizontal Position
-3
-2
-1
0
1
9380
9390
9400
9410
9420
9430
9440
9450
9460
9470
9480
Vertical Position
7
8
9
10
11
adult-04, Saccade, Saccade # = 43
adult-4597871955335632108, Residual Per Sample = 0.49
Horizontal Position
-20
-15
-10
-5
1.47
1.475
1.48
1.485
1.49
1.495
1.5
10^4
Vertical Position
-15
-10
-5
0
infant-14, Saccade, Saccade # = 13
infant-4595441564971508404, Residual Per Sample = 0.48
Horizontal Position
10
15
20
3840
3850
3860
3870
3880
3890
3900
3910
3920
Vertical Position
8
10
12
14
16
18
adult-02, Saccade, Saccade # = 15
adult-4596407422096344416, Residual Per Sample = 0.44
Horizontal Position
-12
-10
-8
-6
-4
-2
2180
2200
2220
2240
2260
2280
2300
Vertical Position
-15
-10
-5
infant-56, Saccade, Saccade # = 07
infant-4606386303357509649, Residual Per Sample = 0.42
Horizontal Position
-8
-6
-4
-2
0
2780
2790
2800
2810
2820
2830
2840
2850
Vertical Position
10
15
20

Figure 4:

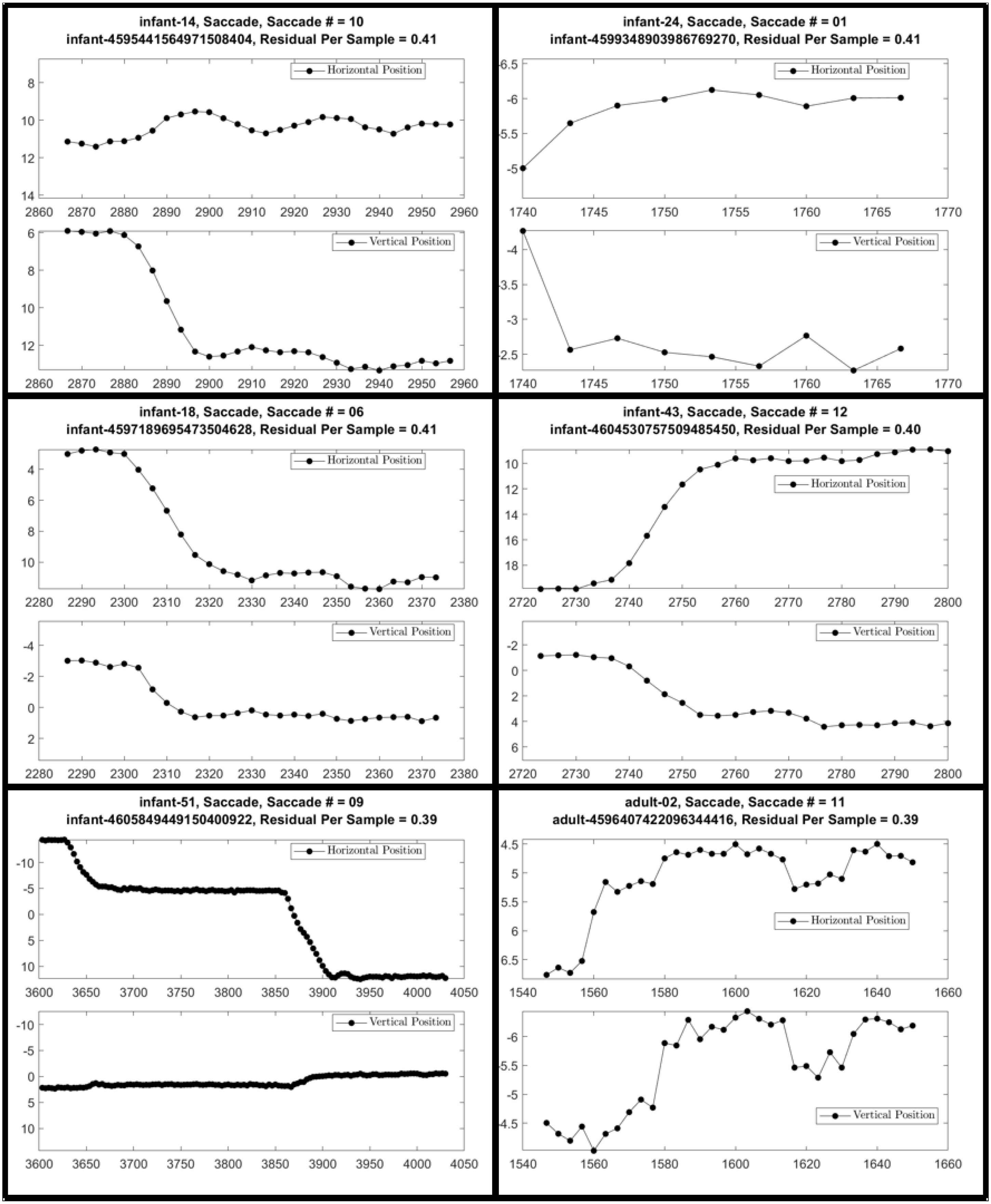

infant-14, Saccade, Saccade # = 10
infant-4595441564971508404, Residual Per Sample = 0.41
Horizontal Position
8
10
12
14
2860 2870 2880 2890 2900 2910 2920 2930 2940 2950 2960
Vertical Position
6
8
10
12
2860 2870 2880 2890 2900 2910 2920 2930 2940 2950 2960
infant-24, Saccade, Saccade # = 01
infant-4599348903986769270, Residual Per Sample = 0.41
Horizontal Position
6.5
-6
5.5
-5
1740 1745 1750 1755 1760 1765 1770
Vertical Position
-4
3.5
-3
2.5
1740 1745 1750 1755 1760 1765 1770
infant-18, Saccade, Saccade # = 06
infant-4597189695473504628, Residual Per Sample = 0.41
Horizontal Position
4
6
8
10
2280 2290 2300 2310 2320 2330 2340 2350 2360 2370 2380
Vertical Position
-4
-2
0
2
2280 2290 2300 2310 2320 2330 2340 2350 2360 2370 2380
infant-43, Saccade, Saccade # = 12
infant-4604530757509485450, Residual Per Sample = 0.40
Horizontal Position
10
12
14
16
18
2720 2730 2740 2750 2760 2770 2780 2790 2800
Vertical Position
-2
0
2
4
6
2720 2730 2740 2750 2760 2770 2780 2790 2800
infant-51, Saccade, Saccade # = 09
infant-4605849449150400922, Residual Per Sample = 0.39
Horizontal Position
-10
-5
0
5
10
3600 3650 3700 3750 3800 3850 3900 3950 4000 4050
Vertical Position
-10
-5
0
5
10
3600 3650 3700 3750 3800 3850 3900 3950 4000 4050
adult-02, Saccade, Saccade # = 11
adult-4596407422096344416, Residual Per Sample = 0.39
Horizontal Position
4.5
5
5.5
6
6.5
1540 1560 1580 1600 1620 1640 1660
Vertical Position
-6
5.5
-5
4.5
1540 1560 1580 1600 1620 1640 1660

Figure 5:

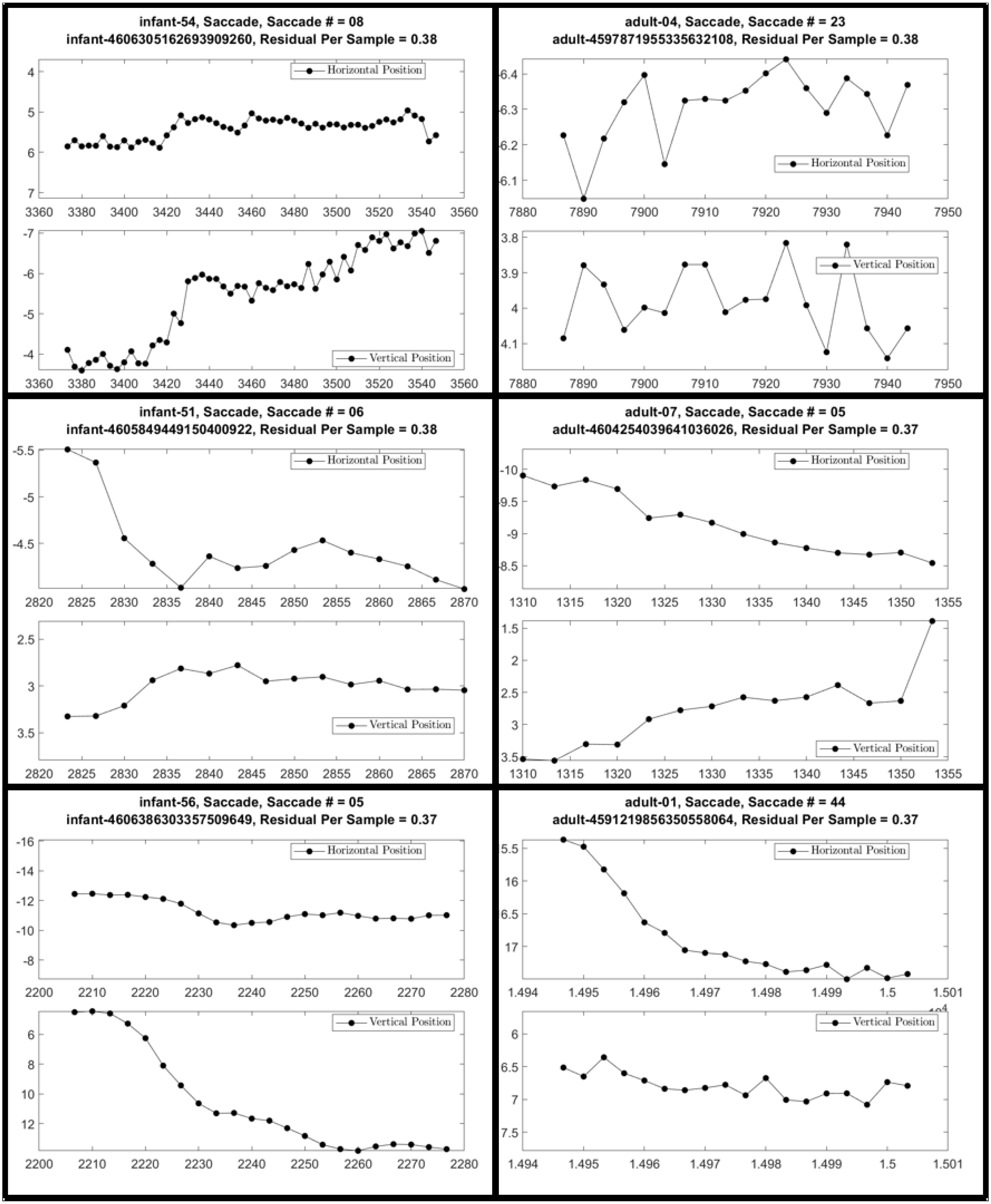

infant-54, Saccade, Saccade # = 08
infant-4606305162693909260, Residual Per Sample = 0.38
Horizontal Position
4
5
6
7
3360 3380 3400 3420 3440 3460 3480 3500 3520 3540 3560
-7
-6
-5
-4
Vertical Position
adult-04, Saccade, Saccade # = 23
adult-4597871955335632108, Residual Per Sample = 0.38
6.4
6.3
6.2
6.1
Horizontal Position
7880 7890 7900 7910 7920 7930 7940 7950
3.8
3.9
4
4.1
Vertical Position
infant-51, Saccade, Saccade # = 06
infant-4605849449150400922, Residual Per Sample = 0.38
-5.5
-5
-4.5
Horizontal Position
2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870
2.5
3
3.5
Vertical Position
adult-07, Saccade, Saccade # = 05
adult-4604254039641036026, Residual Per Sample = 0.37
-10
9.5
-9
8.5
Horizontal Position
1310 1315 1320 1325 1330 1335 1340 1345 1350 1355
1.5
2
2.5
3
3.5
Vertical Position
infant-56, Saccade, Saccade # = 05
infant-4606386303357509649, Residual Per Sample = 0.37
-16
-14
-12
-10
-8
Horizontal Position
2200 2210 2220 2230 2240 2250 2260 2270 2280
6
8
10
12
Vertical Position
adult-01, Saccade, Saccade # = 44
adult-4591219856350558064, Residual Per Sample = 0.37
5.5
16
6.5
17
Horizontal Position
1.494 1.495 1.496 1.497 1.498 1.499 1.5 1.501
10^4
6
6.5
7
7.5
Vertical Position

Figure 6:

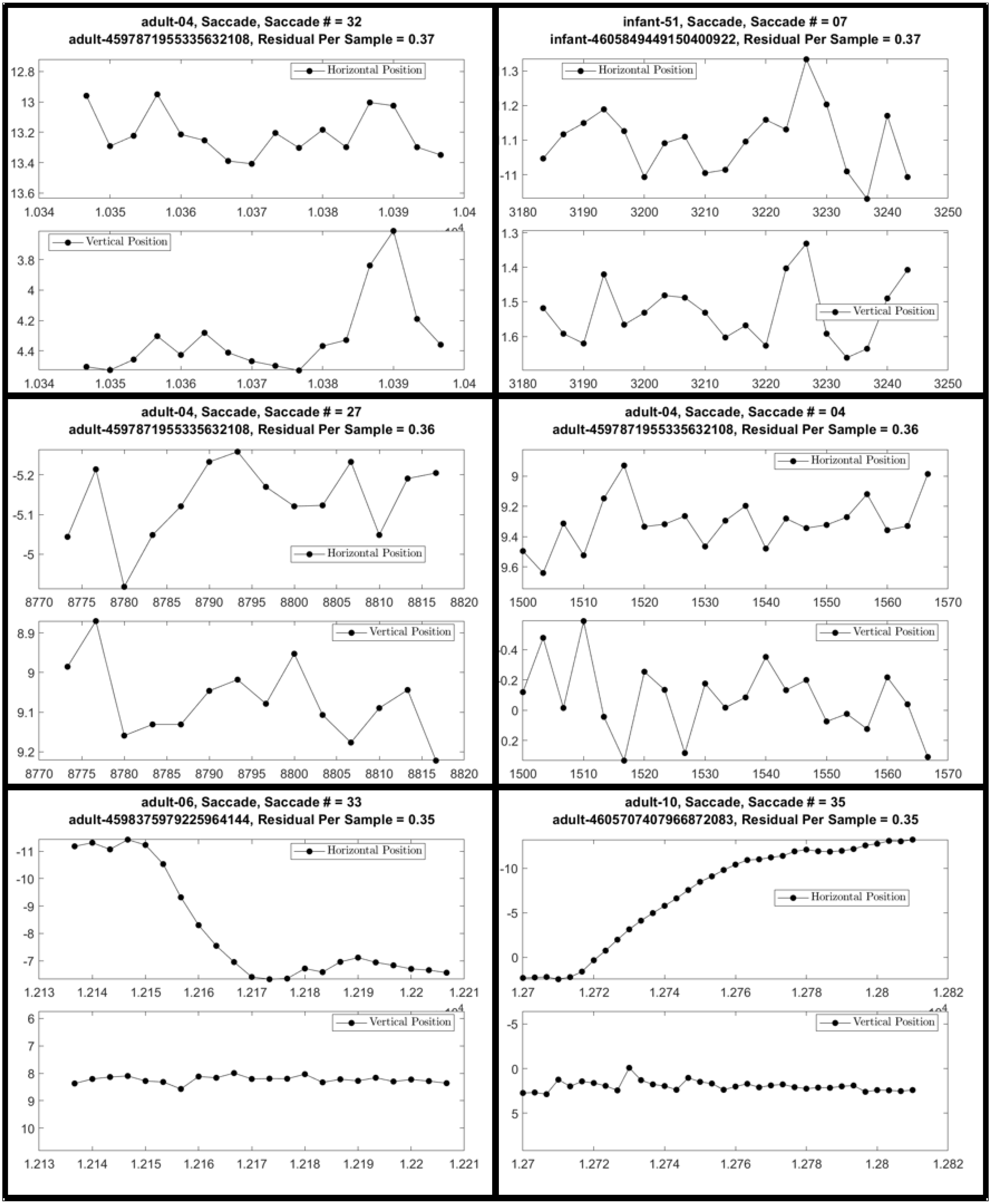

adult-04, Saccade, Saccade # = 32
adult-4597871955335632108, Residual Per Sample = 0.37
Horizontal Position
12.8
13
13.2
13.4
13.6
1.034
1.035
1.036
1.037
1.038
1.039
1.04
10^4
Vertical Position
3.8
4
4.2
4.4
infant-51, Saccade, Saccade # = 07
infant-4605849449150400922, Residual Per Sample = 0.37
Horizontal Position
1.3
1.2
1.1
-11
3180
3190
3200
3210
3220
3230
3240
3250
Vertical Position
1.3
1.4
1.5
1.6
adult-04, Saccade, Saccade # = 27
adult-4597871955335632108, Residual Per Sample = 0.36
Horizontal Position
-5.2
-5.1
-5
8770
8775
8780
8785
8790
8795
8800
8805
8810
8815
8820
Vertical Position
8.9
9
9.1
9.2
adult-04, Saccade, Saccade # = 04
adult-4597871955335632108, Residual Per Sample = 0.36
Horizontal Position
9
9.2
9.4
9.6
1500
1510
1520
1530
1540
1550
1560
1570
Vertical Position
-0.4
-0.2
0
0.2
adult-06, Saccade, Saccade # = 33
adult-4598375979225964144, Residual Per Sample = 0.35
Horizontal Position
-11
-10
-9
-8
-7
1.213
1.214
1.215
1.216
1.217
1.218
1.219
1.22
1.221
10^4
Vertical Position
6
7
8
9
10
adult-10, Saccade, Saccade # = 35
adult-4605707407966872083, Residual Per Sample = 0.35
Horizontal Position
-10
-5
0
5
1.27
1.272
1.274
1.276
1.278
1.28
1.282
10^4
Vertical Position
-5
0
5

Figure 7:

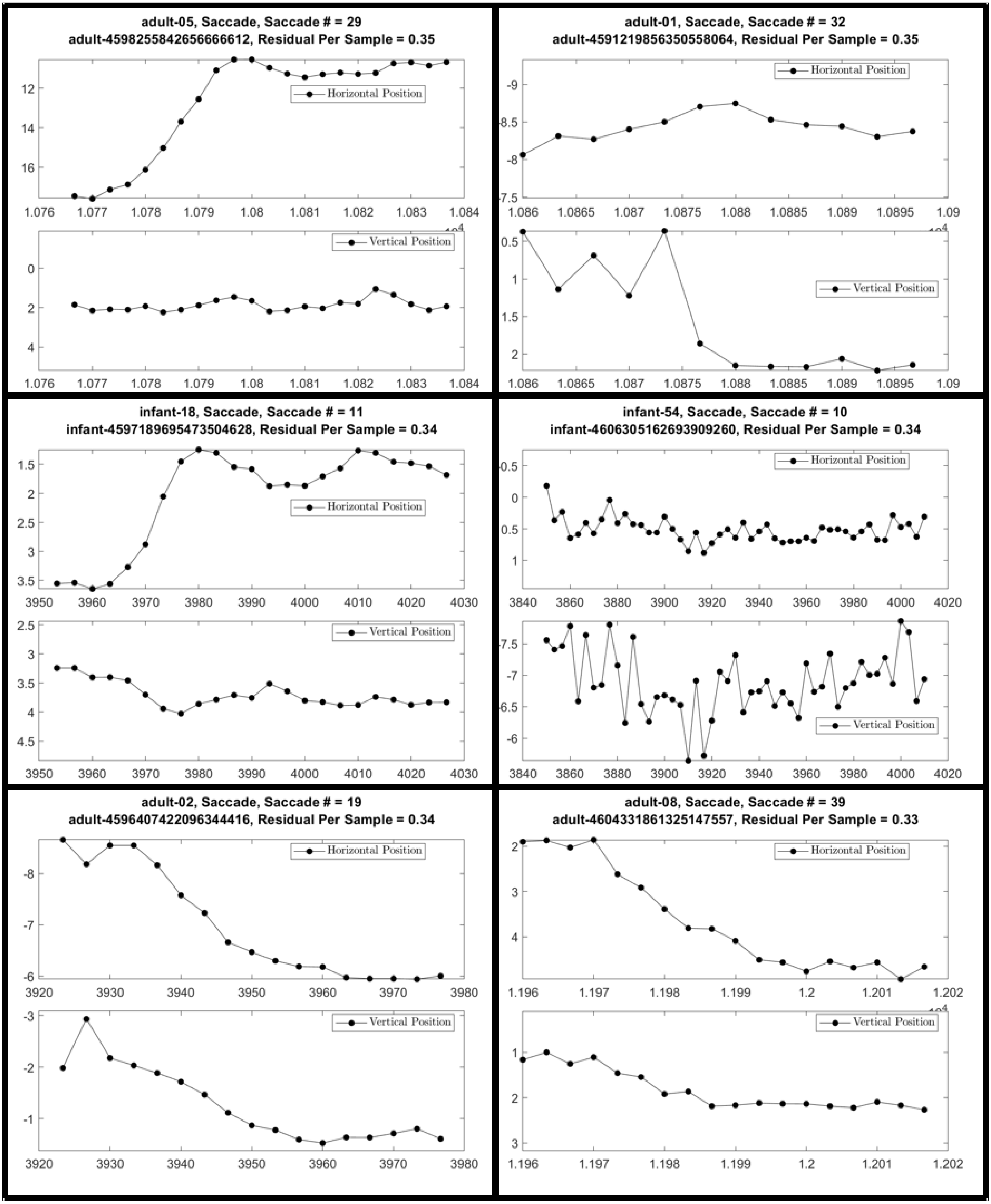

adult-05, Saccade, Saccade # = 29
adult-4598255842656666612, Residual Per Sample = 0.35
Horizontal Position
12
14
16
1.076
1.077
1.078
1.079
1.08
1.081
1.082
1.083
1.084
Vertical Position
0
2
4
1.076
1.077
1.078
1.079
1.08
1.081
1.082
1.083
1.084
adult-01, Saccade, Saccade # = 32
adult-4591219856350558064, Residual Per Sample = 0.35
Horizontal Position
-9
-8.5
-8
-7.5
1.086
1.0865
1.087
1.0875
1.088
1.0885
1.089
1.0895
1.09
Vertical Position
0.5
1
1.5
2
1.086
1.0865
1.087
1.0875
1.088
1.0885
1.089
1.0895
1.09
infant-18, Saccade, Saccade # = 11
infant-4597189695473504628, Residual Per Sample = 0.34
Horizontal Position
1.5
2
2.5
3
3.5
3950
3960
3970
3980
3990
4000
4010
4020
4030
Vertical Position
2.5
3
3.5
4
4.5
3950
3960
3970
3980
3990
4000
4010
4020
4030
infant-54, Saccade, Saccade # = 10
infant-4606305162693909260, Residual Per Sample = 0.34
Horizontal Position
-0.5
0
0.5
1
3840
3860
3880
3900
3920
3940
3960
3980
4000
4020
Vertical Position
-7.5
-7
-6.5
-6
3840
3860
3880
3900
3920
3940
3960
3980
4000
4020
adult-02, Saccade, Saccade # = 19
adult-4596407422096344416, Residual Per Sample = 0.34
Horizontal Position
-8
-7
-6
3920
3930
3940
3950
3960
3970
3980
Vertical Position
-3
-2
-1
3920
3930
3940
3950
3960
3970
3980
adult-08, Saccade, Saccade # = 39
adult-4604331861325147557, Residual Per Sample = 0.33
Horizontal Position
2
3
4
1.196
1.197
1.198
1.199
1.2
1.201
1.202
Vertical Position
1
2
3
1.196
1.197
1.198
1.199
1.2
1.201
1.202

Figure 8:

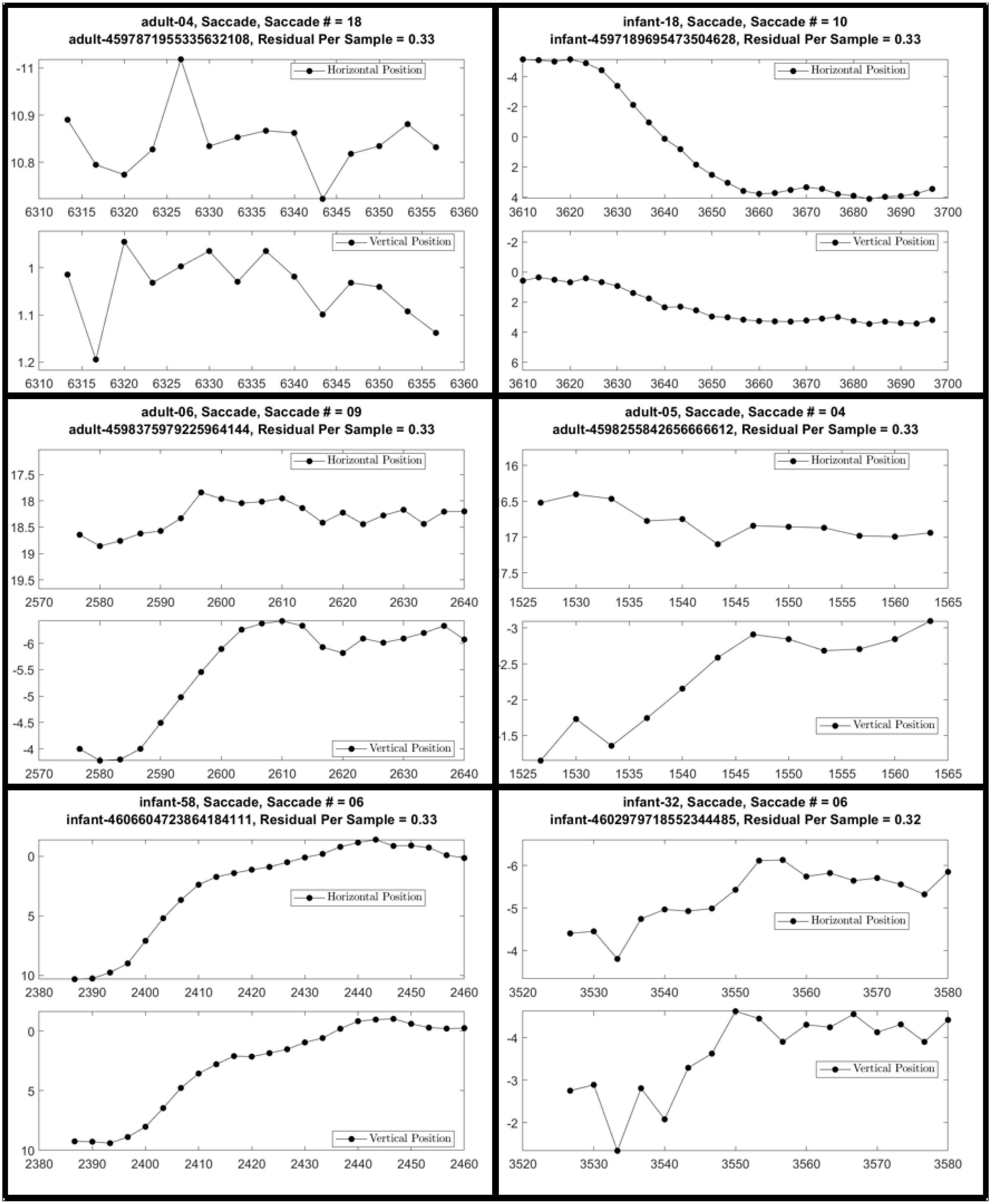

adult-04, Saccade, Saccade # = 18
adult-4597871955335632108, Residual Per Sample = 0.33
Horizontal Position
-11
10.9
10.8
6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360
Vertical Position
1
1.1
1.2
6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360
infant-18, Saccade, Saccade # = 10
infant-4597189695473504628, Residual Per Sample = 0.33
Horizontal Position
-4
-2
0
2
4
3610 3620 3630 3640 3650 3660 3670 3680 3690 3700
Vertical Position
-2
0
2
4
6
3610 3620 3630 3640 3650 3660 3670 3680 3690 3700
adult-06, Saccade, Saccade # = 09
adult-4598375979225964144, Residual Per Sample = 0.33
Horizontal Position
17.5
18
18.5
19
19.5
2570 2580 2590 2600 2610 2620 2630 2640
Vertical Position
-6
-5.5
-5
-4.5
-4
2570 2580 2590 2600 2610 2620 2630 2640
adult-05, Saccade, Saccade # = 04
adult-4598255842656666612, Residual Per Sample = 0.33
Horizontal Position
16
6.5
17
7.5
1525 1530 1535 1540 1545 1550 1555 1560 1565
Vertical Position
-3
2.5
-2
1.5
1525 1530 1535 1540 1545 1550 1555 1560 1565
infant-58, Saccade, Saccade # = 06
infant-4606604723864184111, Residual Per Sample = 0.33
Horizontal Position
0
5
10
2380 2390 2400 2410 2420 2430 2440 2450 2460
Vertical Position
0
5
10
2380 2390 2400 2410 2420 2430 2440 2450 2460
infant-32, Saccade, Saccade # = 06
infant-4602979718552344485, Residual Per Sample = 0.32
Horizontal Position
-6
-5
-4
3520 3530 3540 3550 3560 3570 3580
Vertical Position
-4
-3
-2
3520 3530 3540 3550 3560 3570 3580

Figure 9:

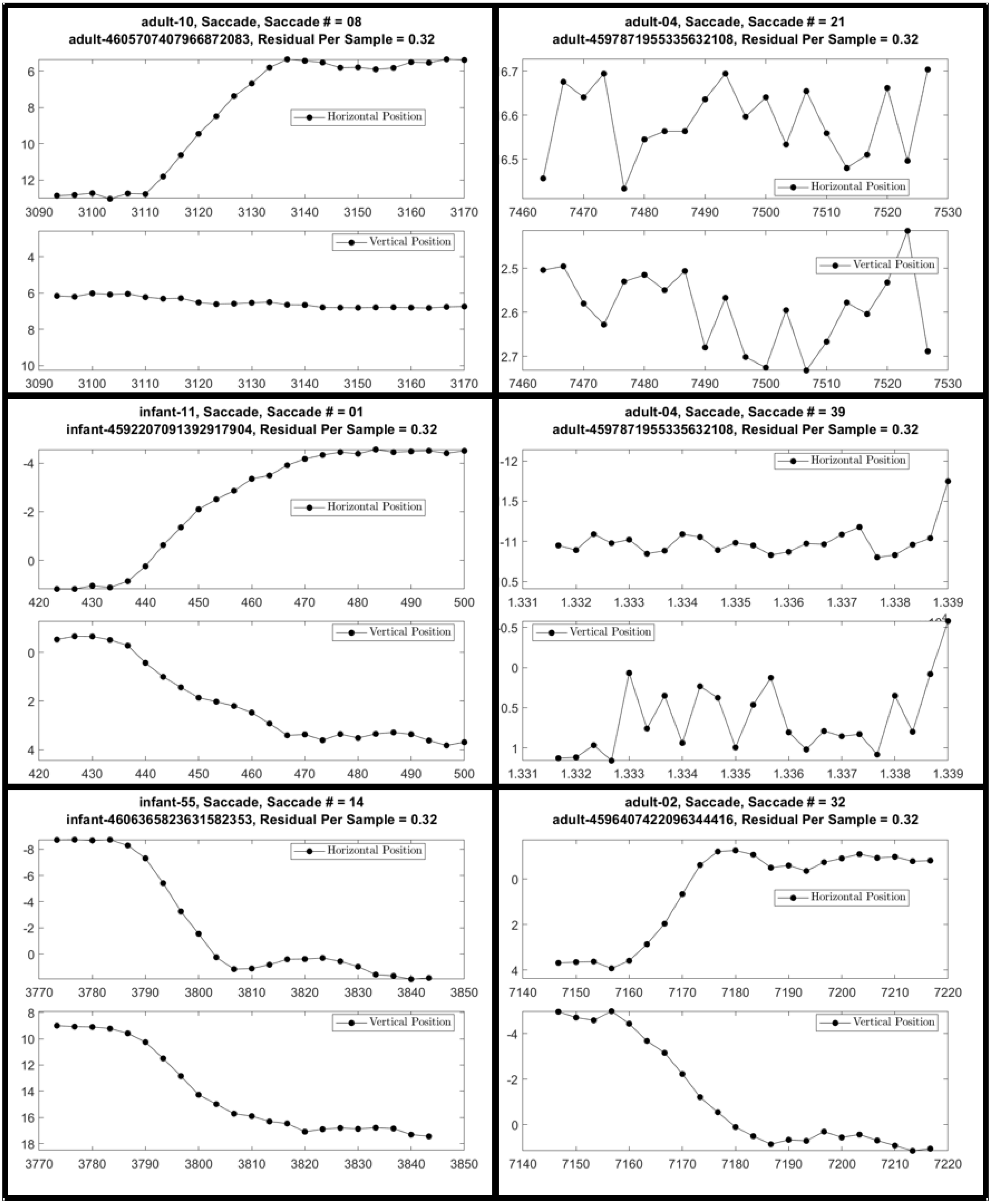

adult-10, Saccade, Saccade # = 08
adult-4605707407966872083, Residual Per Sample = 0.32
Horizontal Position
6
8
10
12
3090
3100
3110
3120
3130
3140
3150
3160
3170
Vertical Position
4
6
8
10
adult-04, Saccade, Saccade # = 21
adult-4597871955335632108, Residual Per Sample = 0.32
Horizontal Position
6.7
6.6
6.5
7460
7470
7480
7490
7500
7510
7520
7530
Vertical Position
2.5
2.6
2.7
infant-11, Saccade, Saccade # = 01
infant-4592207091392917904, Residual Per Sample = 0.32
Horizontal Position
-4
-2
0
420
430
440
450
460
470
480
490
500
Vertical Position
0
2
4
adult-04, Saccade, Saccade # = 39
adult-4597871955335632108, Residual Per Sample = 0.32
Horizontal Position
-12
1.5
-11
0.5
1.331
1.332
1.333
1.334
1.335
1.336
1.337
1.338
1.339
10⁴
Vertical Position
-0.5
0
0.5
1
infant-55, Saccade, Saccade # = 14
infant-4606365823631582353, Residual Per Sample = 0.32
Horizontal Position
-8
-6
-4
-2
0
3770
3780
3790
3800
3810
3820
3830
3840
3850
Vertical Position
8
10
12
14
16
18
adult-02, Saccade, Saccade # = 32
adult-4596407422096344416, Residual Per Sample = 0.32
Horizontal Position
0
2
4
7140
7150
7160
7170
7180
7190
7200
7210
7220
Vertical Position
-4
-2
0

Figure 10:

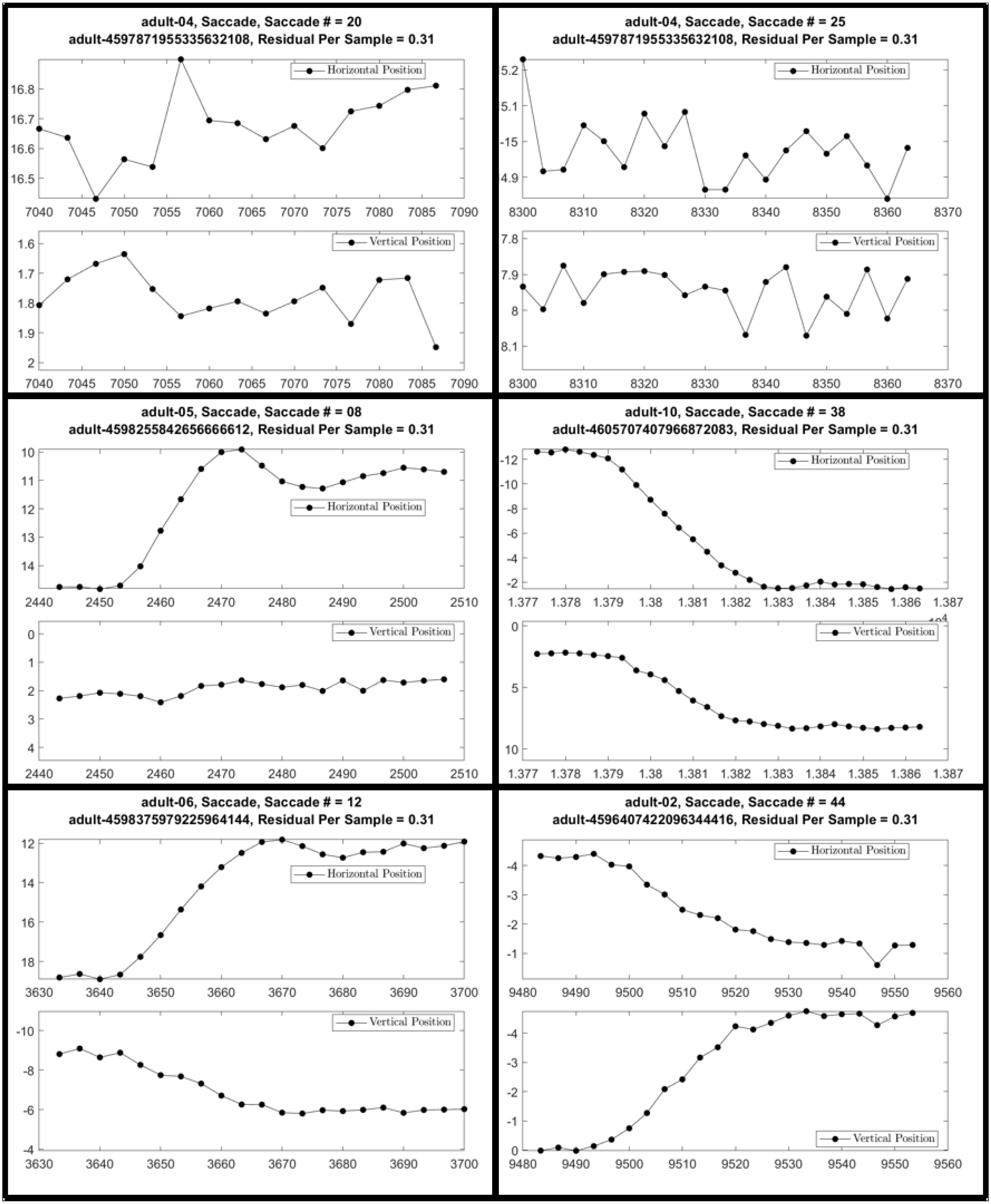

adult-04, Saccade, Saccade # = 20
adult-4597871955335632108, Residual Per Sample = 0.31
Horizontal Position
16.8
16.7
16.6
16.5
7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090
Vertical Position
1.6
1.7
1.8
1.9
2
7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090
adult-04, Saccade, Saccade # = 25
adult-4597871955335632108, Residual Per Sample = 0.31
Horizontal Position
5.2
5.1
-15
4.9
8300 8310 8320 8330 8340 8350 8360 8370
Vertical Position
7.8
7.9
8
8.1
8300 8310 8320 8330 8340 8350 8360 8370
adult-05, Saccade, Saccade # = 08
adult-4598255842656666612, Residual Per Sample = 0.31
Horizontal Position
10
11
12
13
14
2440 2450 2460 2470 2480 2490 2500 2510
Vertical Position
0
1
2
3
4
2440 2450 2460 2470 2480 2490 2500 2510
adult-10, Saccade, Saccade # = 38
adult-4605707407966872083, Residual Per Sample = 0.31
Horizontal Position
-12
-10
-8
-6
-4
-2
1.377 1.378 1.379 1.38 1.381 1.382 1.383 1.384 1.385 1.386 1.387
Vertical Position
0
5
10
1.377 1.378 1.379 1.38 1.381 1.382 1.383 1.384 1.385 1.386 1.387
adult-06, Saccade, Saccade # = 12
adult-4598375979225964144, Residual Per Sample = 0.31
Horizontal Position
12
14
16
18
3630 3640 3650 3660 3670 3680 3690 3700
Vertical Position
-10
-8
-6
-4
3630 3640 3650 3660 3670 3680 3690 3700
adult-02, Saccade, Saccade # = 44
adult-4596407422096344416, Residual Per Sample = 0.31
Horizontal Position
-4
-3
-2
-1
9480 9490 9500 9510 9520 9530 9540 9550 9560
Vertical Position
-4
-3
-2
-1
0
9480 9490 9500 9510 9520 9530 9540 9550 9560

Figure 11:

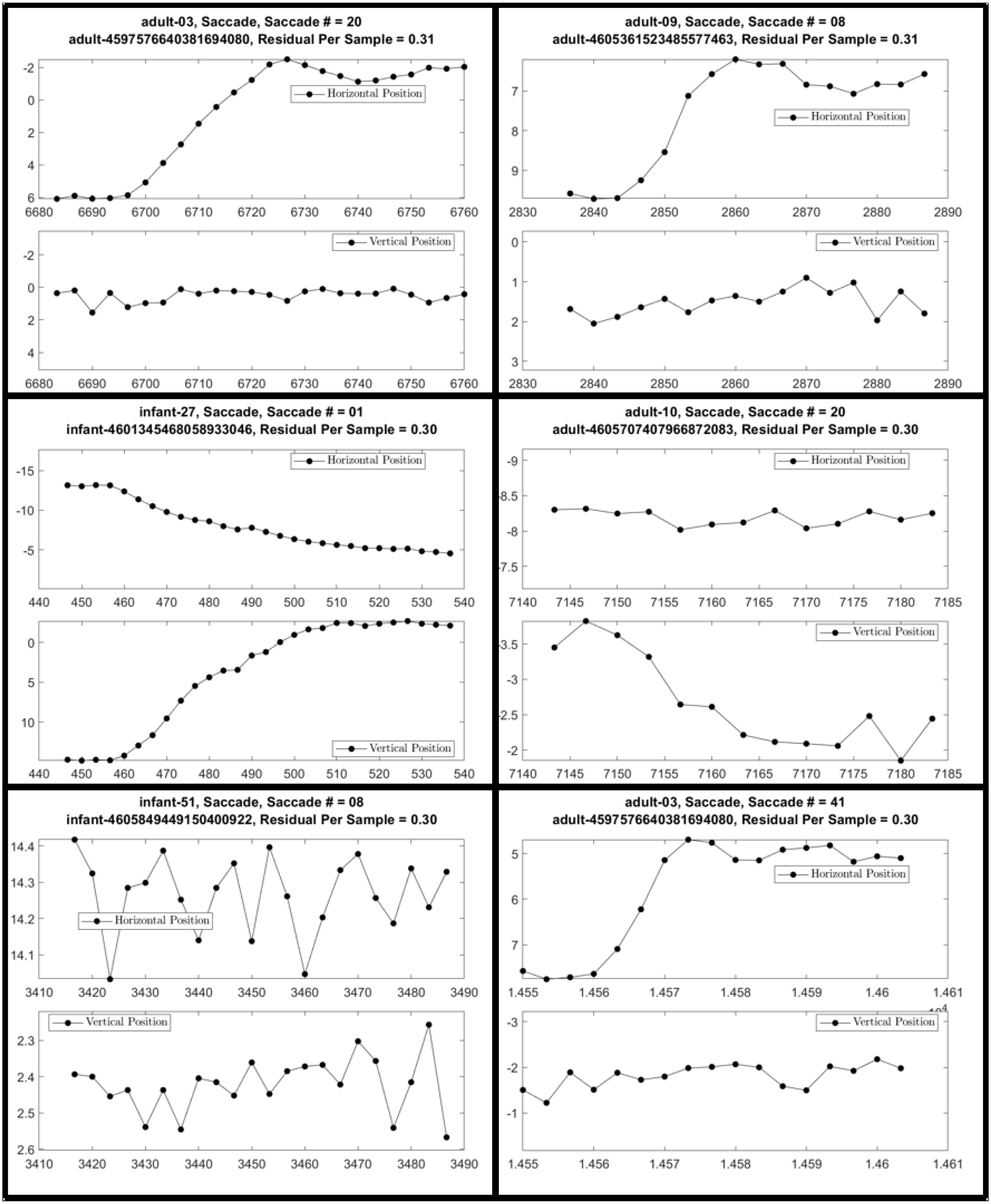

adult-03, Saccade, Saccade # = 20
adult-4597576640381694080, Residual Per Sample = 0.31
Horizontal Position
-2
0
2
4
6
6680
6690
6700
6710
6720
6730
6740
6750
6760
Vertical Position
-2
0
2
4
adult-09, Saccade, Saccade # = 08
adult-4605361523485577463, Residual Per Sample = 0.31
Horizontal Position
7
8
9
2830
2840
2850
2860
2870
2880
2890
Vertical Position
0
1
2
3
infant-27, Saccade, Saccade # = 01
infant-4601345468058933046, Residual Per Sample = 0.30
Horizontal Position
-15
-10
-5
440
450
460
470
480
490
500
510
520
530
540
Vertical Position
0
5
10
adult-10, Saccade, Saccade # = 20
adult-4605707407966872083, Residual Per Sample = 0.30
Horizontal Position
-9
-8.5
-8
-7.5
7140
7145
7150
7155
7160
7165
7170
7175
7180
7185
Vertical Position
-3.5
-3
-2.5
-2
infant-51, Saccade, Saccade # = 08
infant-4605849449150400922, Residual Per Sample = 0.30
Horizontal Position
14.4
14.3
14.2
14.1
3410
3420
3430
3440
3450
3460
3470
3480
3490
Vertical Position
2.3
2.4
2.5
2.6
adult-03, Saccade, Saccade # = 41
adult-4597576640381694080, Residual Per Sample = 0.30
Horizontal Position
5
6
7
1.455
1.456
1.457
1.458
1.459
1.46
1.461
10^4
Vertical Position
-3
-2
-1

Figure 12:

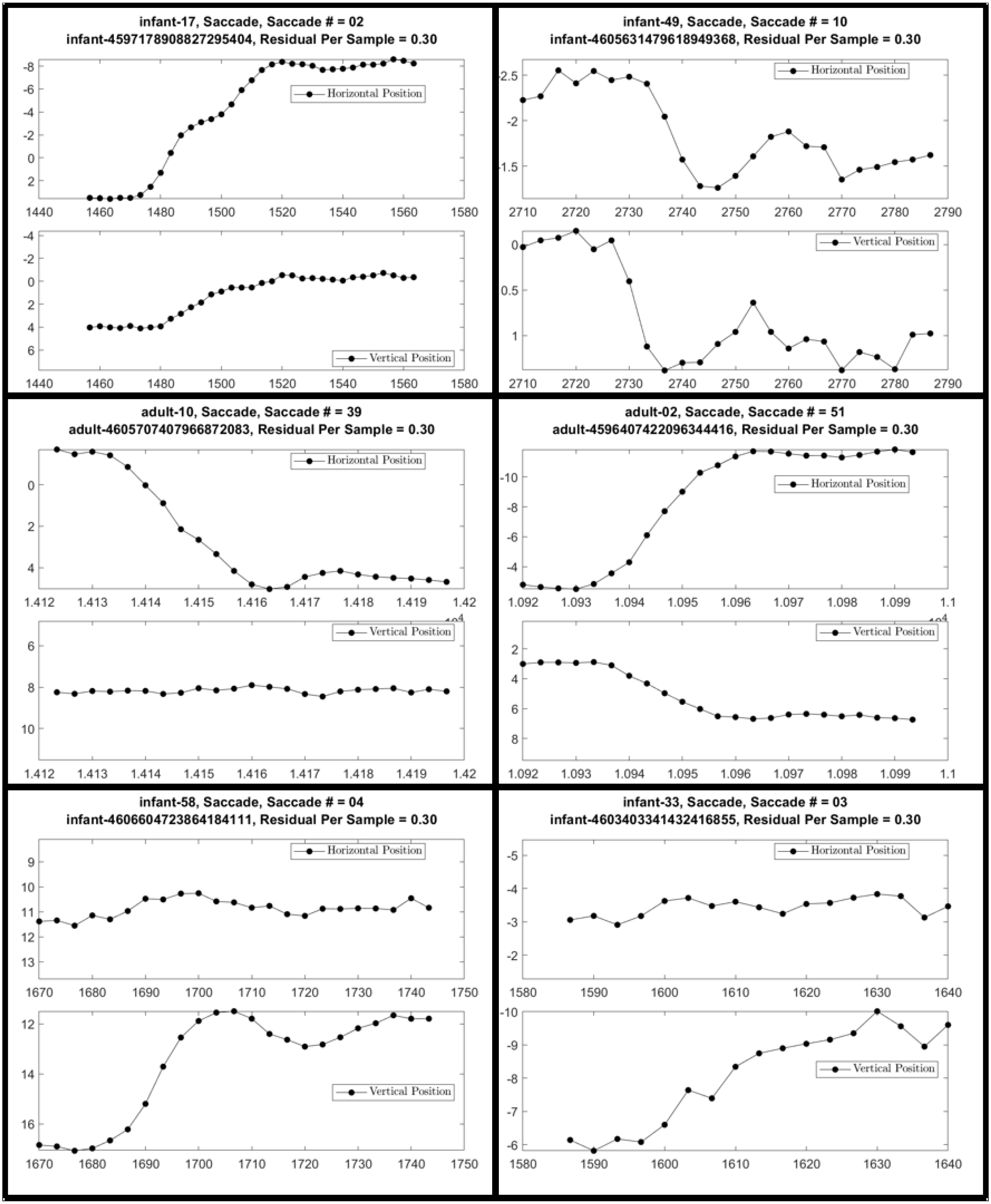
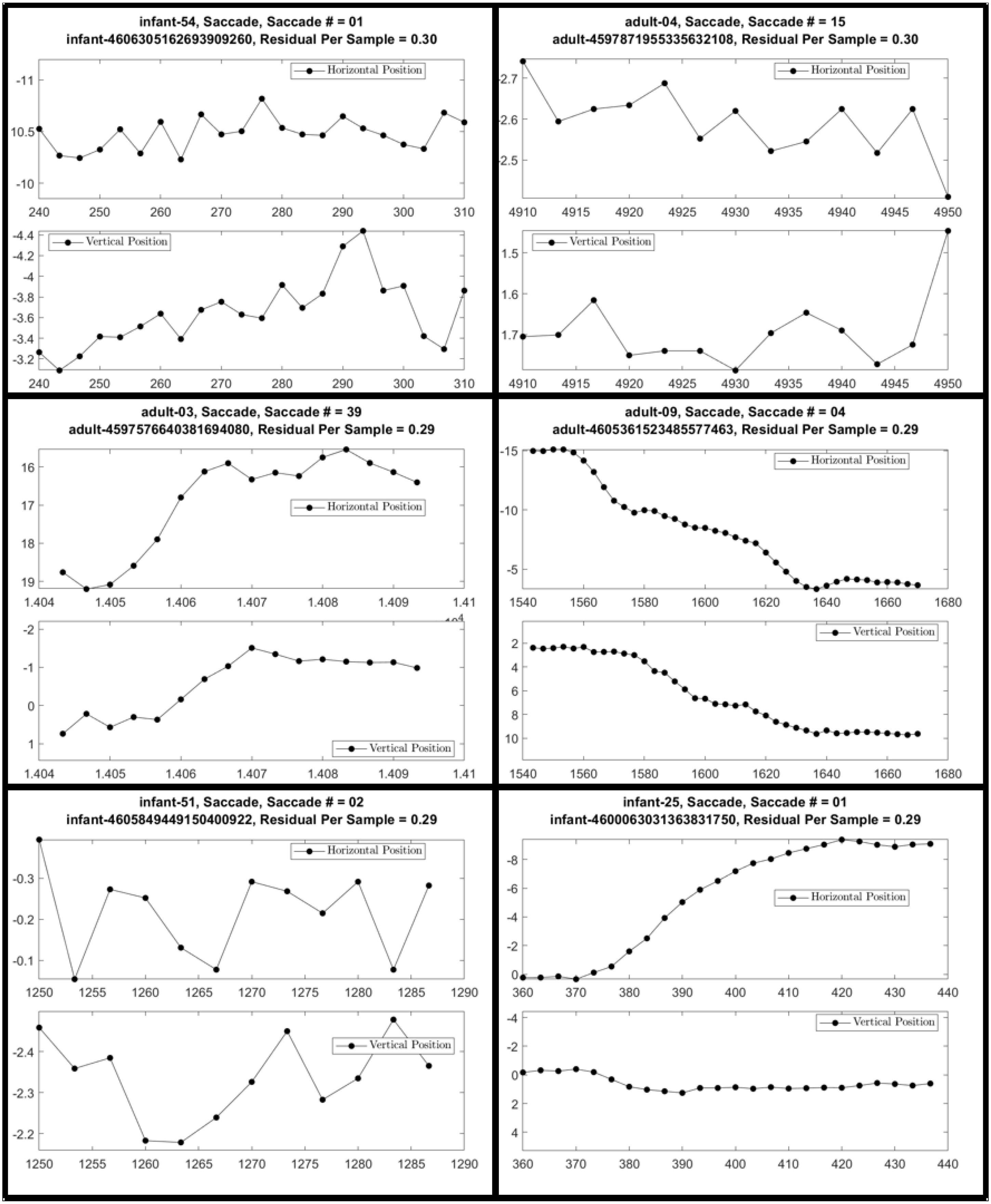

infant-17, Saccade, Saccade # = 02
infant-4597178908827295404, Residual Per Sample = 0.30
Horizontal Position
-8
-6
-4
-2
0
2
1440
1460
1480
1500
1520
1540
1560
1580
Vertical Position
-4
-2
0
2
4
6
infant-49, Saccade, Saccade # = 10
infant-4605631479618949368, Residual Per Sample = 0.30
Horizontal Position
-2.5
-2
-1.5
2710
2720
2730
2740
2750
2760
2770
2780
2790
Vertical Position
0
0.5
1
adult-10, Saccade, Saccade # = 39
adult-4605707407966872083, Residual Per Sample = 0.30
Horizontal Position
0
2
4
1.412
1.413
1.414
1.415
1.416
1.417
1.418
1.419
1.42
Vertical Position
6
8
10
adult-02, Saccade, Saccade # = 51
adult-4596407422096344416, Residual Per Sample = 0.30
Horizontal Position
-10
-8
-6
-4
1.092
1.093
1.094
1.095
1.096
1.097
1.098
1.099
1.1
Vertical Position
2
4
6
8
infant-58, Saccade, Saccade # = 04
infant-4606604723864184111, Residual Per Sample = 0.30
Horizontal Position
9
10
11
12
13
1670
1680
1690
1700
1710
1720
1730
1740
1750
Vertical Position
12
14
16
infant-33, Saccade, Saccade # = 03
infant-4603403341432416855, Residual Per Sample = 0.30
Horizontal Position
-5
-4
-3
-2
1580
1590
1600
1610
1620
1630
1640
Vertical Position
-10
-9
-8
-7
-6

Figure 13:


infant-54, Saccade, Saccade # = 01
infant-4606305162693909260, Residual Per Sample = 0.30

adult-04, Saccade, Saccade # = 15
adult-4597871955335632108, Residual Per Sample = 0.30

adult-03, Saccade, Saccade # = 39
adult-4597576640381694080, Residual Per Sample = 0.29

adult-09, Saccade, Saccade # = 04
adult-4605361523485577463, Residual Per Sample = 0.29

infant-51, Saccade, Saccade # = 02
infant-4605849449150400922, Residual Per Sample = 0.29

infant-25, Saccade, Saccade # = 01
infant-4600063031363831750, Residual Per Sample = 0.29

Figure 14:

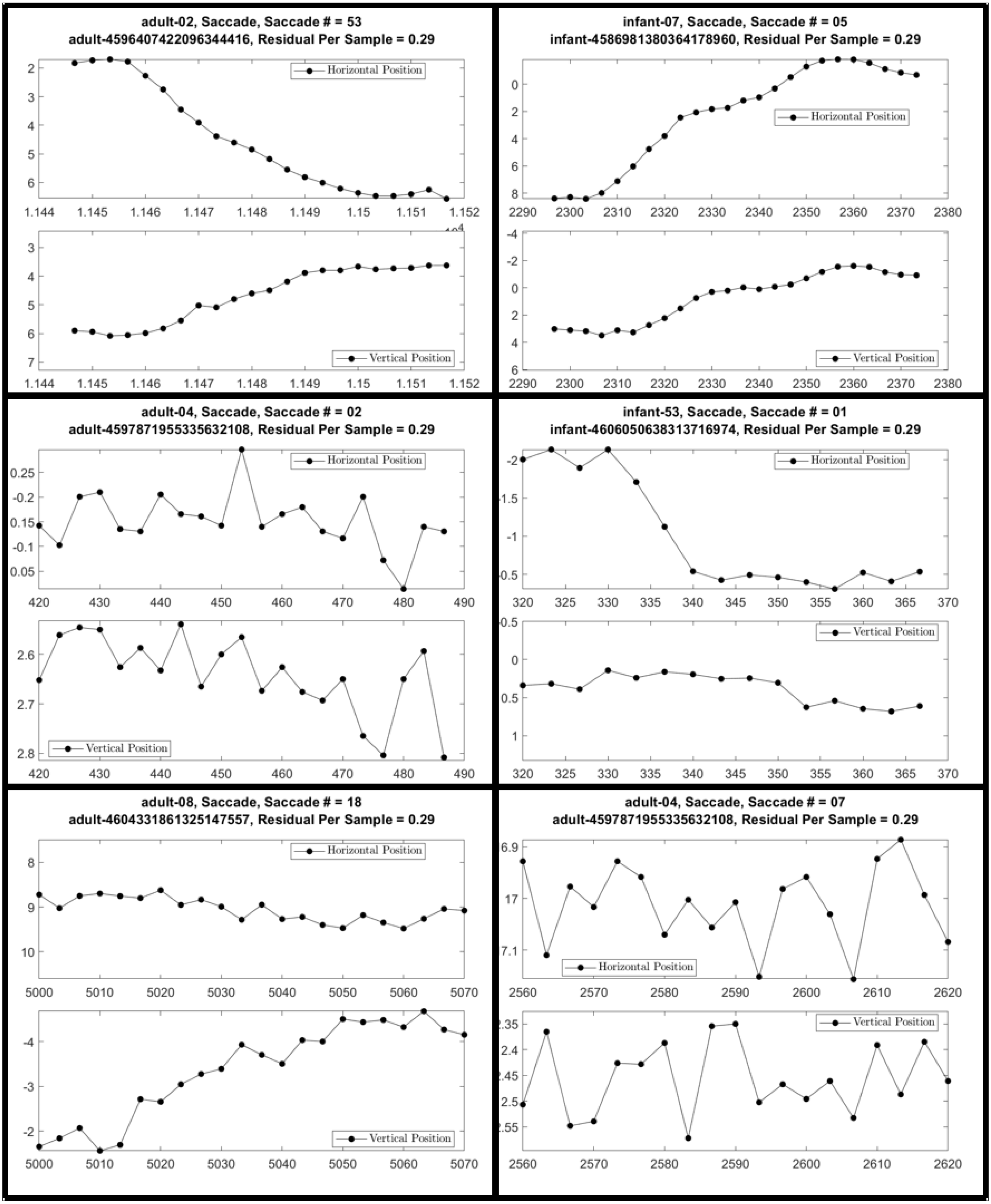

adult-02, Saccade, Saccade # = 53
adult-4596407422096344416, Residual Per Sample = 0.29
Horizontal Position
2
3
4
5
6
1.144
1.145
1.146
1.147
1.148
1.149
1.15
1.151
1.152
×10⁴
Vertical Position
3
4
5
6
7
infant-07, Saccade, Saccade # = 05
infant-4586981380364178960, Residual Per Sample = 0.29
Horizontal Position
0
2
4
6
8
2290
2300
2310
2320
2330
2340
2350
2360
2370
2380
Vertical Position
-4
-2
0
2
4
6
adult-04, Saccade, Saccade # = 02
adult-4597871955335632108, Residual Per Sample = 0.29
Horizontal Position
0.25
-0.2
0.15
-0.1
0.05
420
430
440
450
460
470
480
490
Vertical Position
2.6
2.7
2.8
infant-53, Saccade, Saccade # = 01
infant-4606050638313716974, Residual Per Sample = 0.29
Horizontal Position
-2
-1.5
-1
-0.5
320
325
330
335
340
345
350
355
360
365
370
Vertical Position
-0.5
0
0.5
1
adult-08, Saccade, Saccade # = 18
adult-4604331861325147557, Residual Per Sample = 0.29
Horizontal Position
8
9
10
5000
5010
5020
5030
5040
5050
5060
5070
Vertical Position
-4
-3
-2
adult-04, Saccade, Saccade # = 07
adult-4597871955335632108, Residual Per Sample = 0.29
Horizontal Position
6.9
17
7.1
2560
2570
2580
2590
2600
2610
2620
Vertical Position
2.35
2.4
2.45
2.5
2.55

Figure 15:

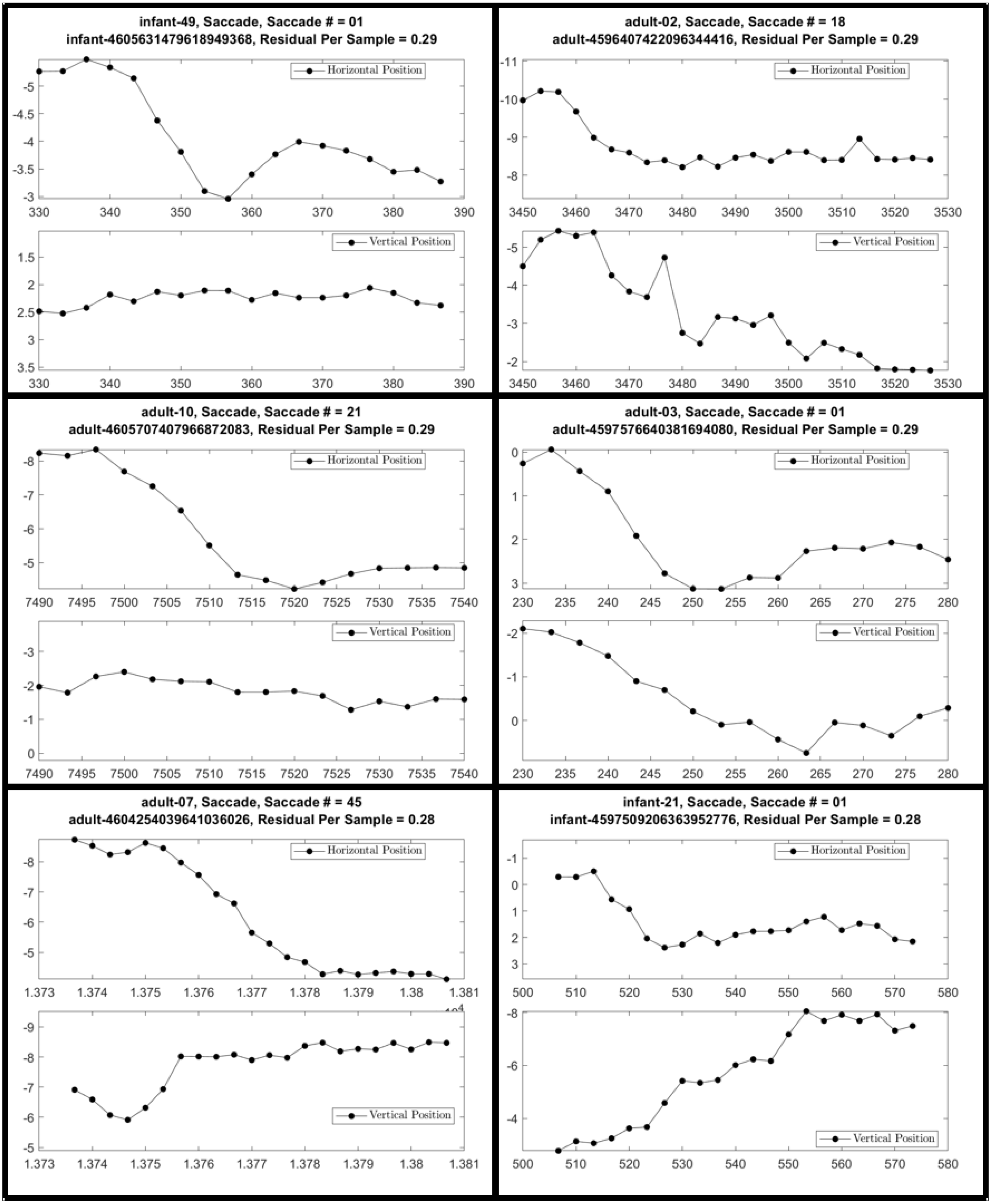

infant-49, Saccade, Saccade # = 01
infant-4605631479618949368, Residual Per Sample = 0.29
Horizontal Position
-5
-4.5
-4
-3.5
-3
330
340
350
360
370
380
390
Vertical Position
1.5
2
2.5
3
3.5
330
340
350
360
370
380
390
adult-02, Saccade, Saccade # = 18
adult-4596407422096344416, Residual Per Sample = 0.29
Horizontal Position
-11
-10
-9
-8
3450
3460
3470
3480
3490
3500
3510
3520
3530
Vertical Position
-5
-4
-3
-2
3450
3460
3470
3480
3490
3500
3510
3520
3530
adult-10, Saccade, Saccade # = 21
adult-4605707407966872083, Residual Per Sample = 0.29
Horizontal Position
-8
-7
-6
-5
7490
7495
7500
7505
7510
7515
7520
7525
7530
7535
7540
Vertical Position
-3
-2
-1
0
7490
7495
7500
7505
7510
7515
7520
7525
7530
7535
7540
adult-03, Saccade, Saccade # = 01
adult-4597576640381694080, Residual Per Sample = 0.29
Horizontal Position
0
1
2
3
230
235
240
245
250
255
260
265
270
275
280
Vertical Position
-2
-1
0
230
235
240
245
250
255
260
265
270
275
280
adult-07, Saccade, Saccade # = 45
adult-4604254039641036026, Residual Per Sample = 0.28
Horizontal Position
-8
-7
-6
-5
1.373
1.374
1.375
1.376
1.377
1.378
1.379
1.38
1.381
10^4
Vertical Position
-9
-8
-7
-6
-5
1.373
1.374
1.375
1.376
1.377
1.378
1.379
1.38
1.381
infant-21, Saccade, Saccade # = 01
infant-4597509206363952776, Residual Per Sample = 0.28
Horizontal Position
-1
0
1
2
3
500
510
520
530
540
550
560
570
580
Vertical Position
-8
-6
-4
500
510
520
530
540
550
560
570
580

Figure 16:

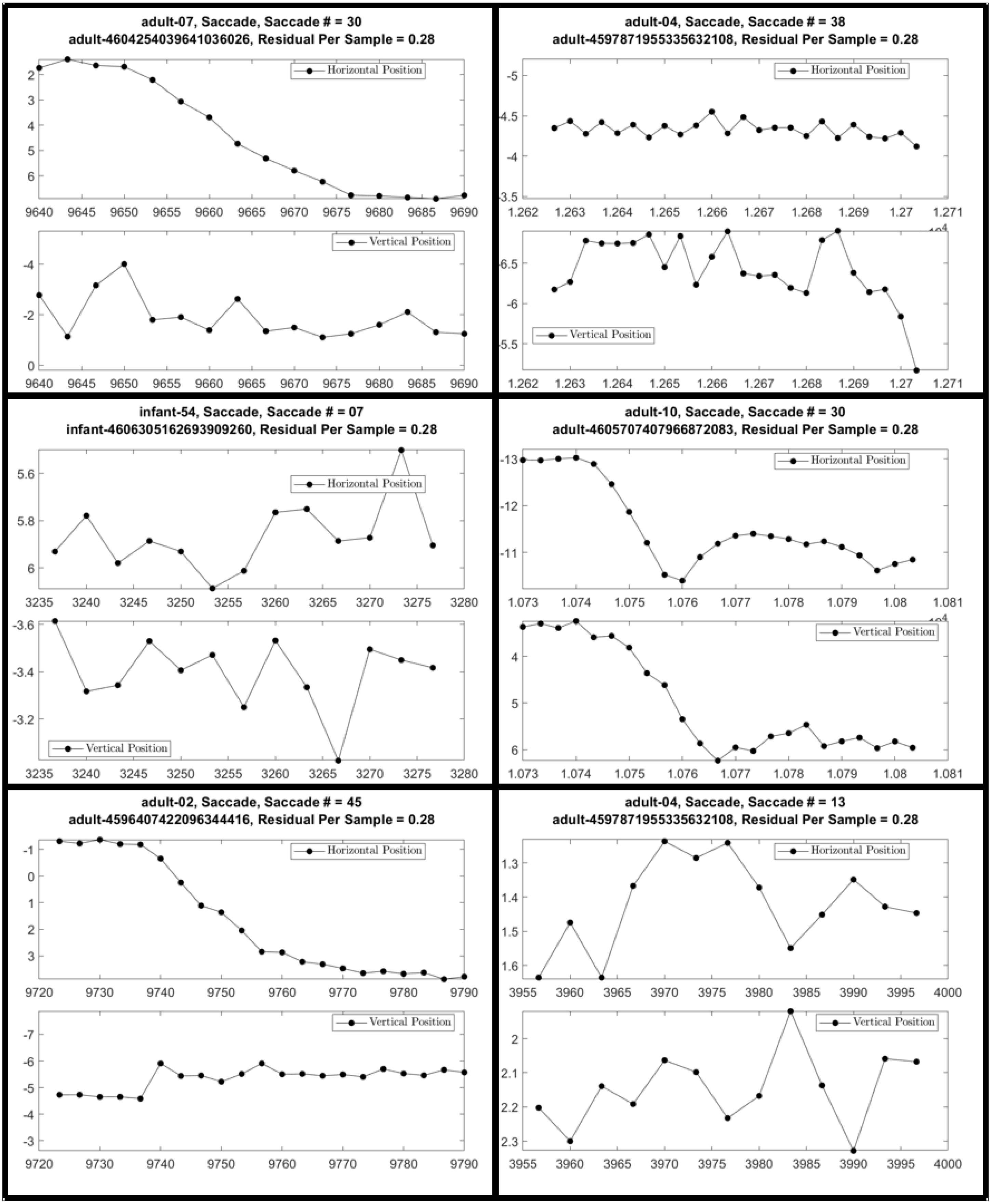

adult-07, Saccade, Saccade # = 30
adult-4604254039641036026, Residual Per Sample = 0.28
Horizontal Position
2
3
4
5
6
9640
9645
9650
9655
9660
9665
9670
9675
9680
9685
9690
Vertical Position
-4
-2
0
9640
9645
9650
9655
9660
9665
9670
9675
9680
9685
9690
adult-04, Saccade, Saccade # = 38
adult-4597871955335632108, Residual Per Sample = 0.28
Horizontal Position
-5
-4.5
-4
-3.5
1.262
1.263
1.264
1.265
1.266
1.267
1.268
1.269
1.27
1.271
Vertical Position
-6.5
-6
-5.5
1.262
1.263
1.264
1.265
1.266
1.267
1.268
1.269
1.27
1.271
infant-54, Saccade, Saccade # = 07
infant-4606305162693909260, Residual Per Sample = 0.28
Horizontal Position
5.6
5.8
6
3235
3240
3245
3250
3255
3260
3265
3270
3275
3280
-3.6
-3.4
-3.2
Vertical Position
3235
3240
3245
3250
3255
3260
3265
3270
3275
3280
adult-10, Saccade, Saccade # = 30
adult-4605707407966872083, Residual Per Sample = 0.28
Horizontal Position
-13
-12
-11
1.073
1.074
1.075
1.076
1.077
1.078
1.079
1.08
1.081
Vertical Position
4
5
6
1.073
1.074
1.075
1.076
1.077
1.078
1.079
1.08
1.081
adult-02, Saccade, Saccade # = 45
adult-4596407422096344416, Residual Per Sample = 0.28
Horizontal Position
-1
0
1
2
3
9720
9730
9740
9750
9760
9770
9780
9790
Vertical Position
-7
-6
-5
-4
-3
9720
9730
9740
9750
9760
9770
9780
9790
adult-04, Saccade, Saccade # = 13
adult-4597871955335632108, Residual Per Sample = 0.28
Horizontal Position
1.3
1.4
1.5
1.6
3955
3960
3965
3970
3975
3980
3985
3990
3995
4000
Vertical Position
2
2.1
2.2
2.3
3955
3960
3965
3970
3975
3980
3985
3990
3995
4000

Figure 17:

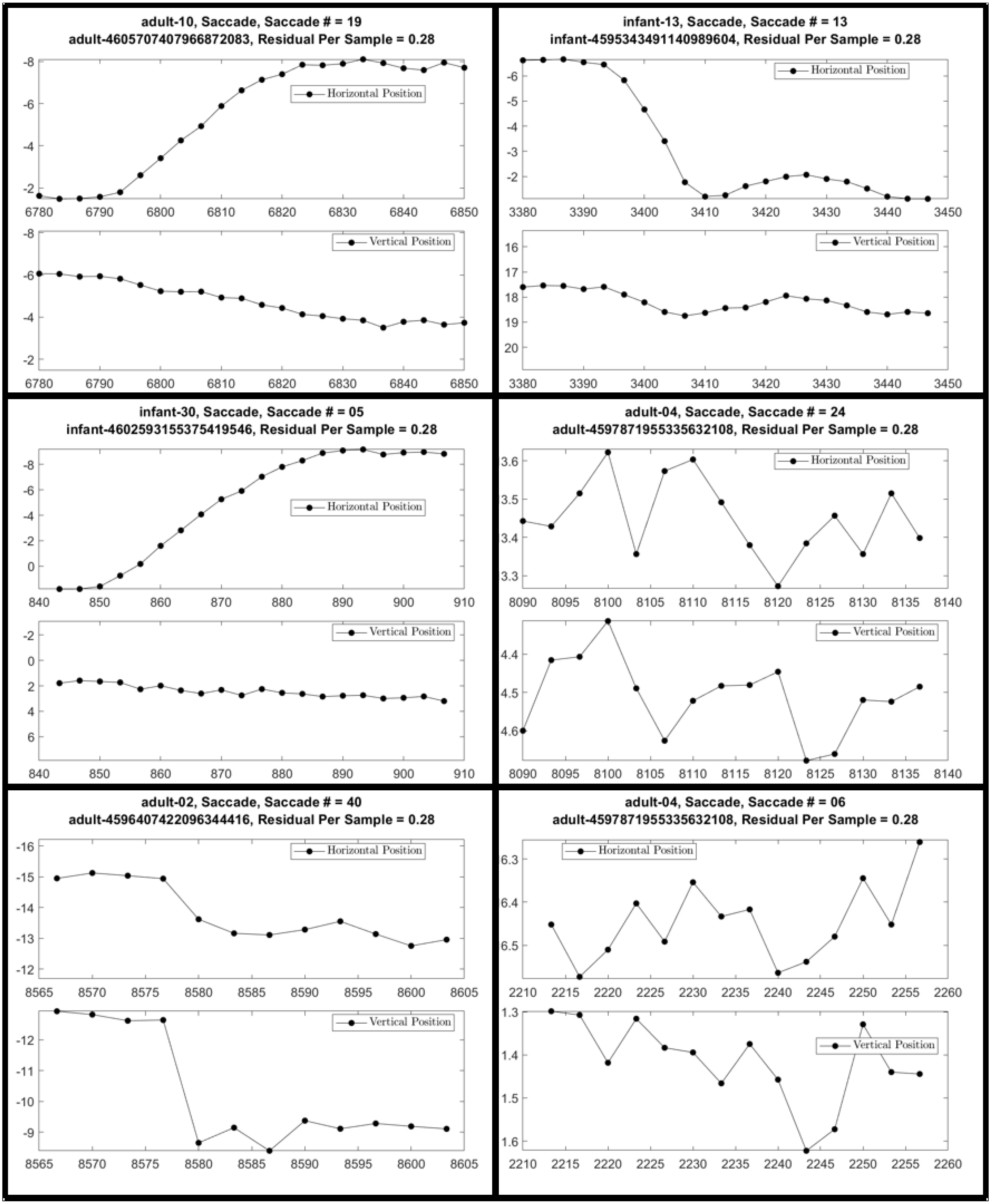

adult-10, Saccade, Saccade # = 19
adult-4605707407966872083, Residual Per Sample = 0.28
Horizontal Position
-8
-6
-4
-2
6780
6790
6800
6810
6820
6830
6840
6850
Vertical Position
-8
-6
-4
-2
infant-13, Saccade, Saccade # = 13
infant-4595343491140989604, Residual Per Sample = 0.28
Horizontal Position
-6
-5
-4
-3
-2
3380
3390
3400
3410
3420
3430
3440
3450
Vertical Position
16
17
18
19
20
infant-30, Saccade, Saccade # = 05
infant-4602593155375419546, Residual Per Sample = 0.28
Horizontal Position
-8
-6
-4
-2
0
840
850
860
870
880
890
900
910
Vertical Position
-2
0
2
4
6
adult-04, Saccade, Saccade # = 24
adult-4597871955335632108, Residual Per Sample = 0.28
Horizontal Position
3.6
3.5
3.4
3.3
8090
8095
8100
8105
8110
8115
8120
8125
8130
8135
8140
Vertical Position
4.4
4.5
4.6
adult-02, Saccade, Saccade # = 40
adult-4596407422096344416, Residual Per Sample = 0.28
Horizontal Position
-16
-15
-14
-13
-12
8565
8570
8575
8580
8585
8590
8595
8600
8605
Vertical Position
-12
-11
-10
-9
adult-04, Saccade, Saccade # = 06
adult-4597871955335632108, Residual Per Sample = 0.28
Horizontal Position
6.3
6.4
6.5
2210
2215
2220
2225
2230
2235
2240
2245
2250
2255
2260
Vertical Position
1.3
1.4
1.5
1.6

Figure 18:

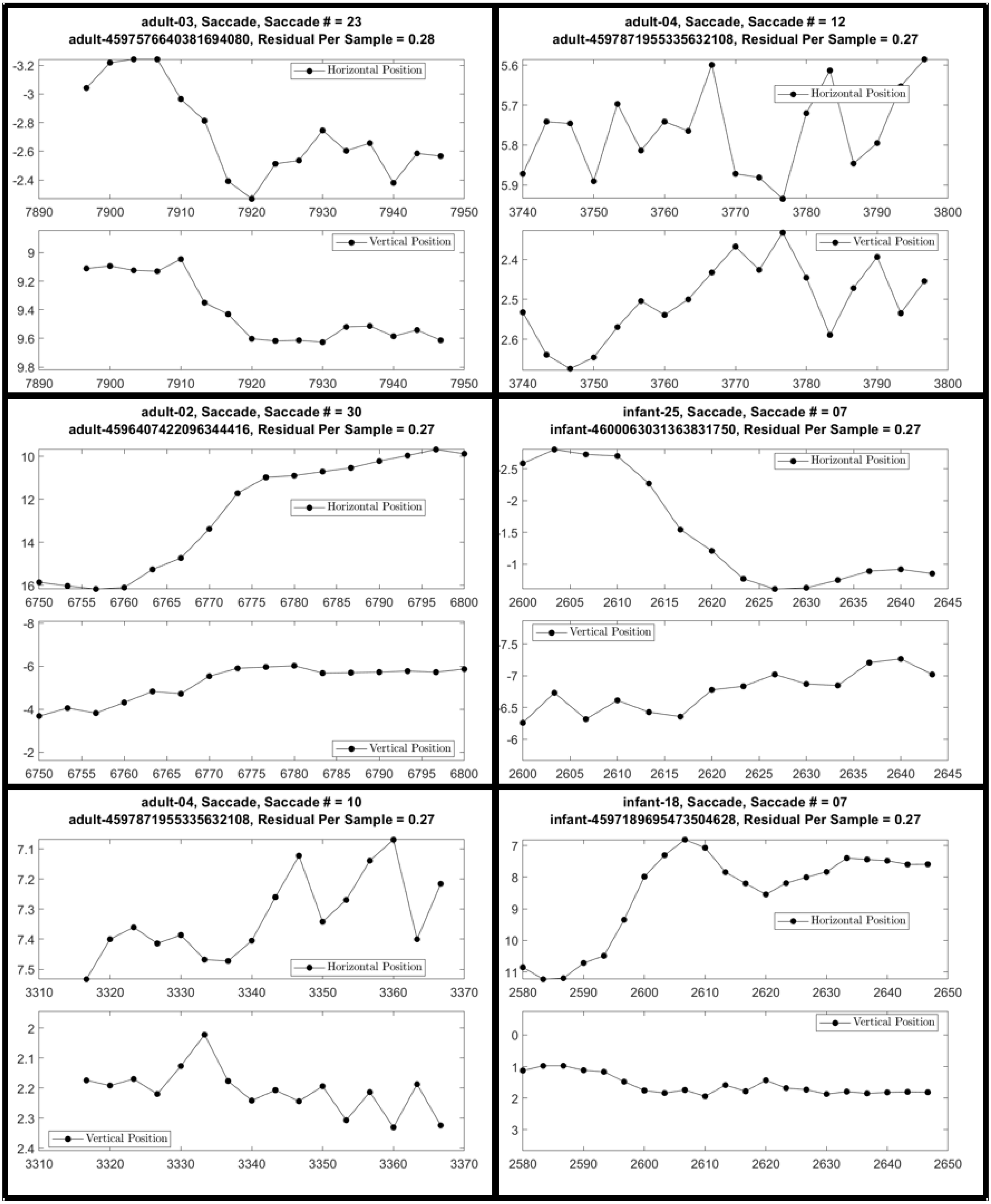

adult-03, Saccade, Saccade # = 23
adult-4597576640381694080, Residual Per Sample = 0.28
Horizontal Position
-3.2
-3
-2.8
-2.6
-2.4
7890
7900
7910
7920
7930
7940
7950
Vertical Position
9
9.2
9.4
9.6
9.8
adult-04, Saccade, Saccade # = 12
adult-4597871955335632108, Residual Per Sample = 0.27
Horizontal Position
5.6
5.7
5.8
5.9
3740
3750
3760
3770
3780
3790
3800
Vertical Position
2.4
2.5
2.6
adult-02, Saccade, Saccade # = 30
adult-4596407422096344416, Residual Per Sample = 0.27
Horizontal Position
10
12
14
16
6750
6755
6760
6765
6770
6775
6780
6785
6790
6795
6800
Vertical Position
-8
-6
-4
-2
infant-25, Saccade, Saccade # = 07
infant-4600063031363831750, Residual Per Sample = 0.27
Horizontal Position
2.5
-2
1.5
-1
2600
2605
2610
2615
2620
2625
2630
2635
2640
2645
Vertical Position
7.5
-7
6.5
-6
adult-04, Saccade, Saccade # = 10
adult-4597871955335632108, Residual Per Sample = 0.27
Horizontal Position
7.1
7.2
7.3
7.4
7.5
3310
3320
3330
3340
3350
3360
3370
Vertical Position
2
2.1
2.2
2.3
2.4
infant-18, Saccade, Saccade # = 07
infant-4597189695473504628, Residual Per Sample = 0.27
Horizontal Position
7
8
9
10
11
2580
2590
2600
2610
2620
2630
2640
2650
Vertical Position
0
1
2
3

Figure 19:

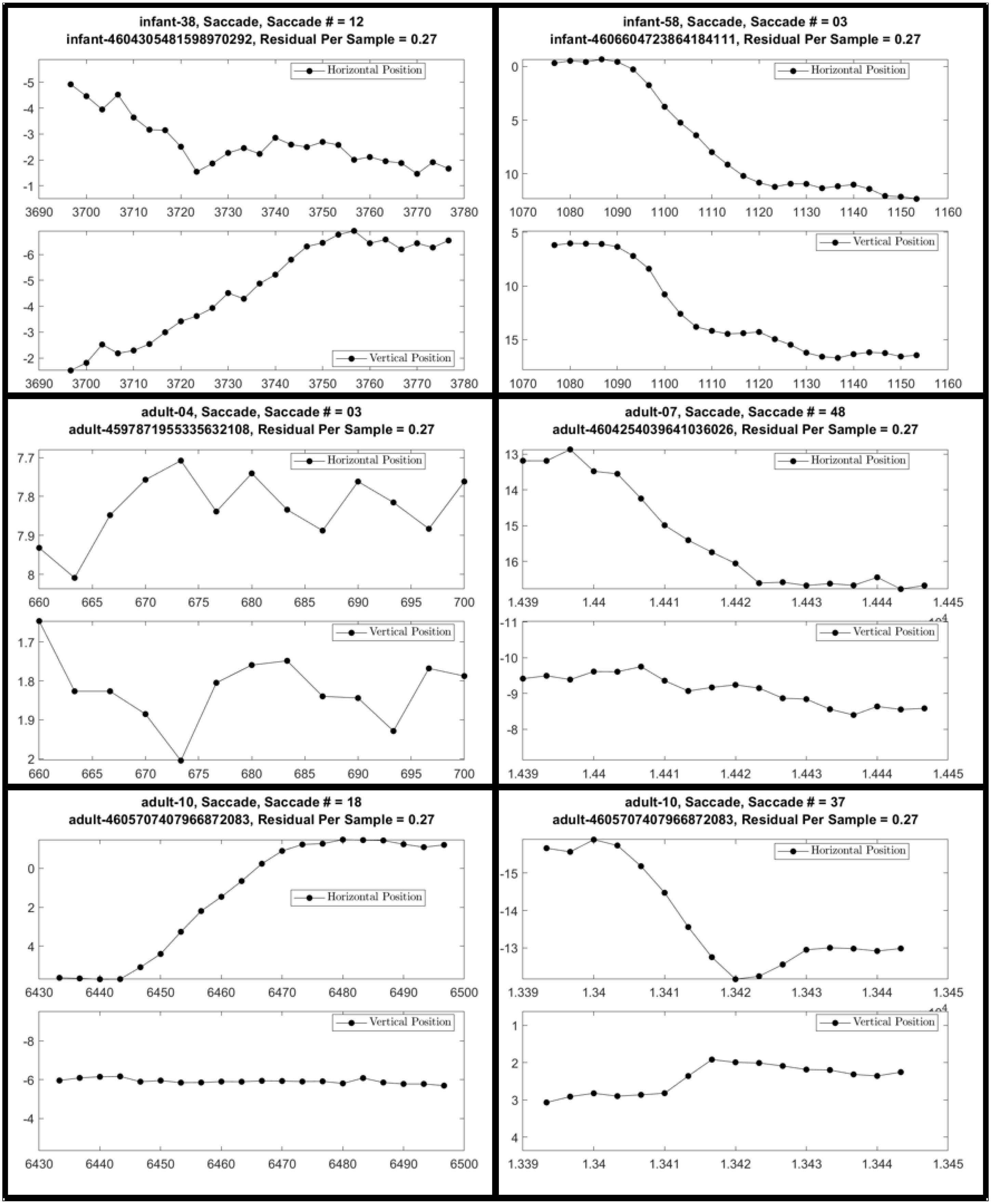
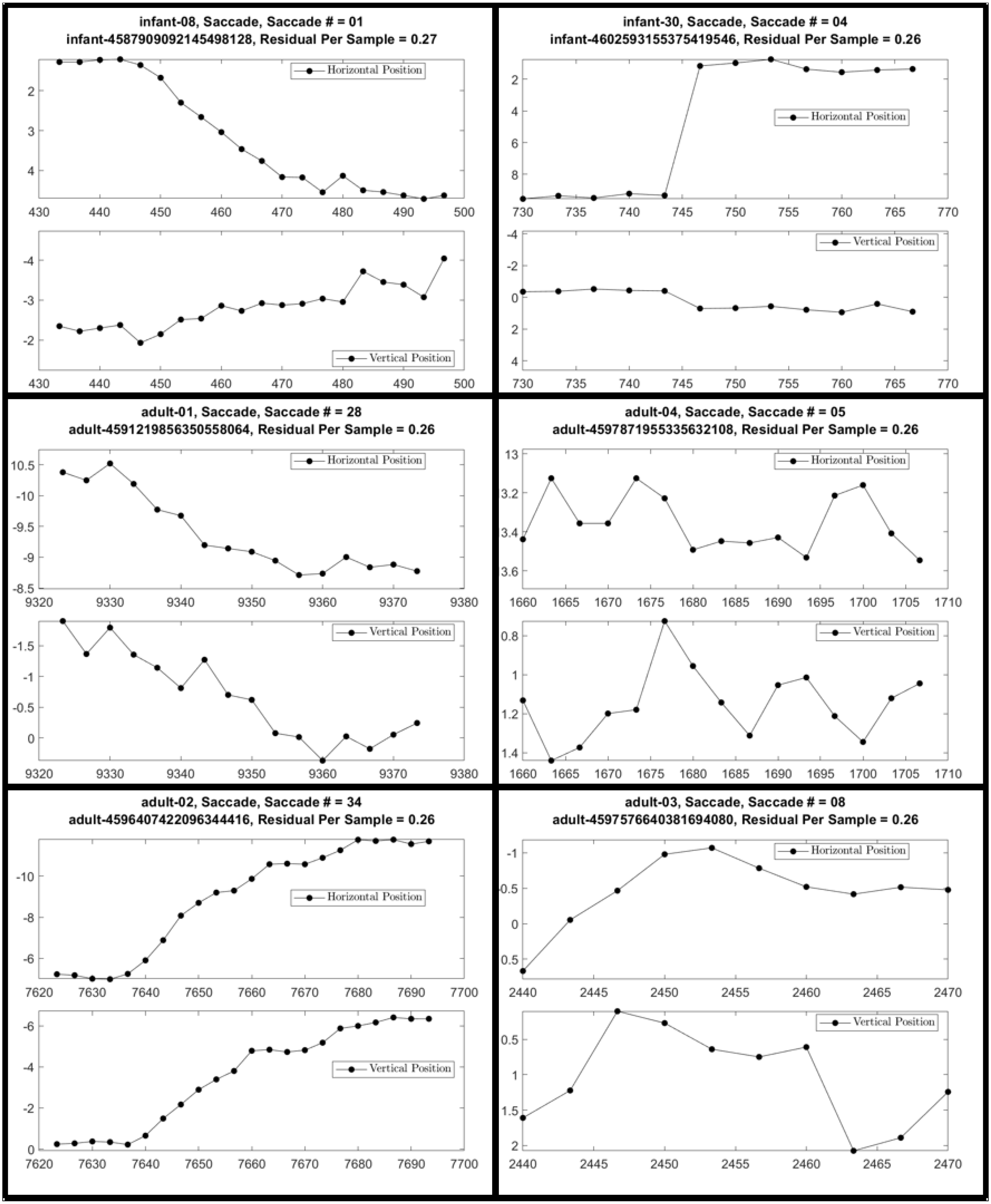

infant-38, Saccade, Saccade # = 12
infant-4604305481598970292, Residual Per Sample = 0.27
Horizontal Position
-5
-4
-3
-2
-1
3690 3700 3710 3720 3730 3740 3750 3760 3770 3780
-6
-5
-4
-3
-2
Vertical Position
3690 3700 3710 3720 3730 3740 3750 3760 3770 3780
infant-58, Saccade, Saccade # = 03
infant-4606604723864184111, Residual Per Sample = 0.27
Horizontal Position
0
5
10
1070 1080 1090 1100 1110 1120 1130 1140 1150 1160
Vertical Position
5
10
15
1070 1080 1090 1100 1110 1120 1130 1140 1150 1160
adult-04, Saccade, Saccade # = 03
adult-4597871955335632108, Residual Per Sample = 0.27
Horizontal Position
7.7
7.8
7.9
8
660 665 670 675 680 685 690 695 700
Vertical Position
1.7
1.8
1.9
2
660 665 670 675 680 685 690 695 700
adult-07, Saccade, Saccade # = 48
adult-4604254039641036026, Residual Per Sample = 0.27
Horizontal Position
13
14
15
16
1.439 1.44 1.441 1.442 1.443 1.444 1.445
Vertical Position
-11
-10
-9
-8
1.439 1.44 1.441 1.442 1.443 1.444 1.445
adult-10, Saccade, Saccade # = 18
adult-4605707407966872083, Residual Per Sample = 0.27
Horizontal Position
0
2
4
6430 6440 6450 6460 6470 6480 6490 6500
Vertical Position
-8
-6
-4
6430 6440 6450 6460 6470 6480 6490 6500
adult-10, Saccade, Saccade # = 37
adult-4605707407966872083, Residual Per Sample = 0.27
Horizontal Position
-15
-14
-13
1.339 1.34 1.341 1.342 1.343 1.344 1.345
Vertical Position
1
2
3
4
1.339 1.34 1.341 1.342 1.343 1.344 1.345

Figure 20:



infant-08, Saccade, Saccade # = 01
infant-4587909092145498128, Residual Per Sample = 0.27

infant-30, Saccade, Saccade # = 04
infant-4602593155375419546, Residual Per Sample = 0.26

adult-01, Saccade, Saccade # = 28
adult-4591219856350558064, Residual Per Sample = 0.26

adult-04, Saccade, Saccade # = 05
adult-4597871955335632108, Residual Per Sample = 0.26

adult-02, Saccade, Saccade # = 34
adult-4596407422096344416, Residual Per Sample = 0.26

adult-03, Saccade, Saccade # = 08
adult-4597576640381694080, Residual Per Sample = 0.26

Figure 21:

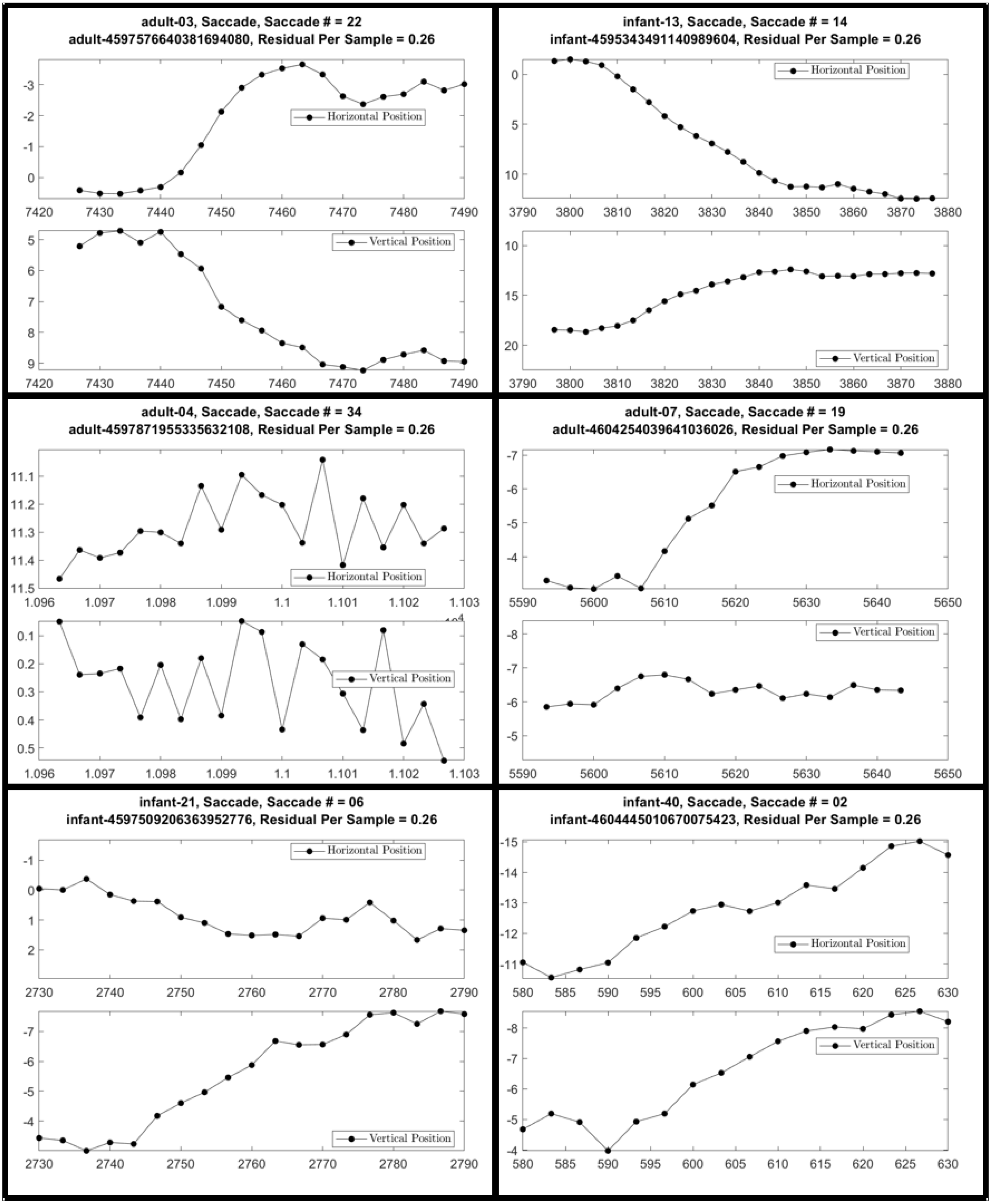

adult-03, Saccade, Saccade # = 22
adult-4597576640381694080, Residual Per Sample = 0.26
Horizontal Position
-3
-2
-1
0
7420 7430 7440 7450 7460 7470 7480 7490
Vertical Position
5
6
7
8
9
7420 7430 7440 7450 7460 7470 7480 7490
infant-13, Saccade, Saccade # = 14
infant-4595343491140989604, Residual Per Sample = 0.26
Horizontal Position
0
5
10
3790 3800 3810 3820 3830 3840 3850 3860 3870 3880
Vertical Position
10
15
20
3790 3800 3810 3820 3830 3840 3850 3860 3870 3880
adult-04, Saccade, Saccade # = 34
adult-4597871955335632108, Residual Per Sample = 0.26
Horizontal Position
11.1
11.2
11.3
11.4
11.5
1.096 1.097 1.098 1.099 1.1 1.101 1.102 1.103
10^4
Vertical Position
0.1
0.2
0.3
0.4
0.5
1.096 1.097 1.098 1.099 1.1 1.101 1.102 1.103
adult-07, Saccade, Saccade # = 19
adult-4604254039641036026, Residual Per Sample = 0.26
Horizontal Position
-7
-6
-5
-4
5590 5600 5610 5620 5630 5640 5650
Vertical Position
-8
-7
-6
-5
5590 5600 5610 5620 5630 5640 5650
infant-21, Saccade, Saccade # = 06
infant-4597509206363952776, Residual Per Sample = 0.26
Horizontal Position
-1
0
1
2
2730 2740 2750 2760 2770 2780 2790
Vertical Position
-7
-6
-5
-4
2730 2740 2750 2760 2770 2780 2790
infant-40, Saccade, Saccade # = 02
infant-4604445010670075423, Residual Per Sample = 0.26
Horizontal Position
-15
-14
-13
-12
-11
580 585 590 595 600 605 610 615 620 625 630
Vertical Position
-8
-7
-6
-5
-4
580 585 590 595 600 605 610 615 620 625 630

Figure 22:

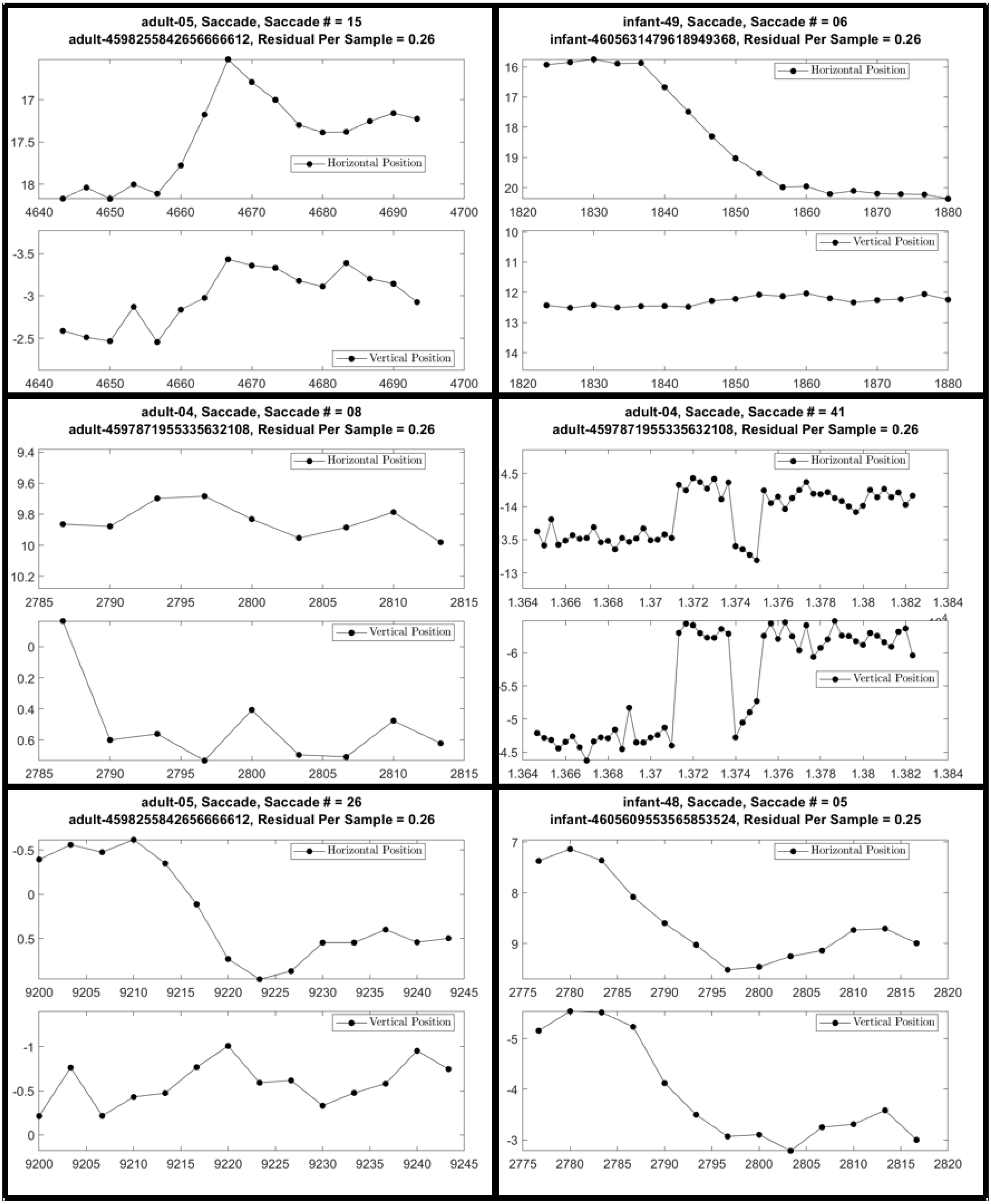
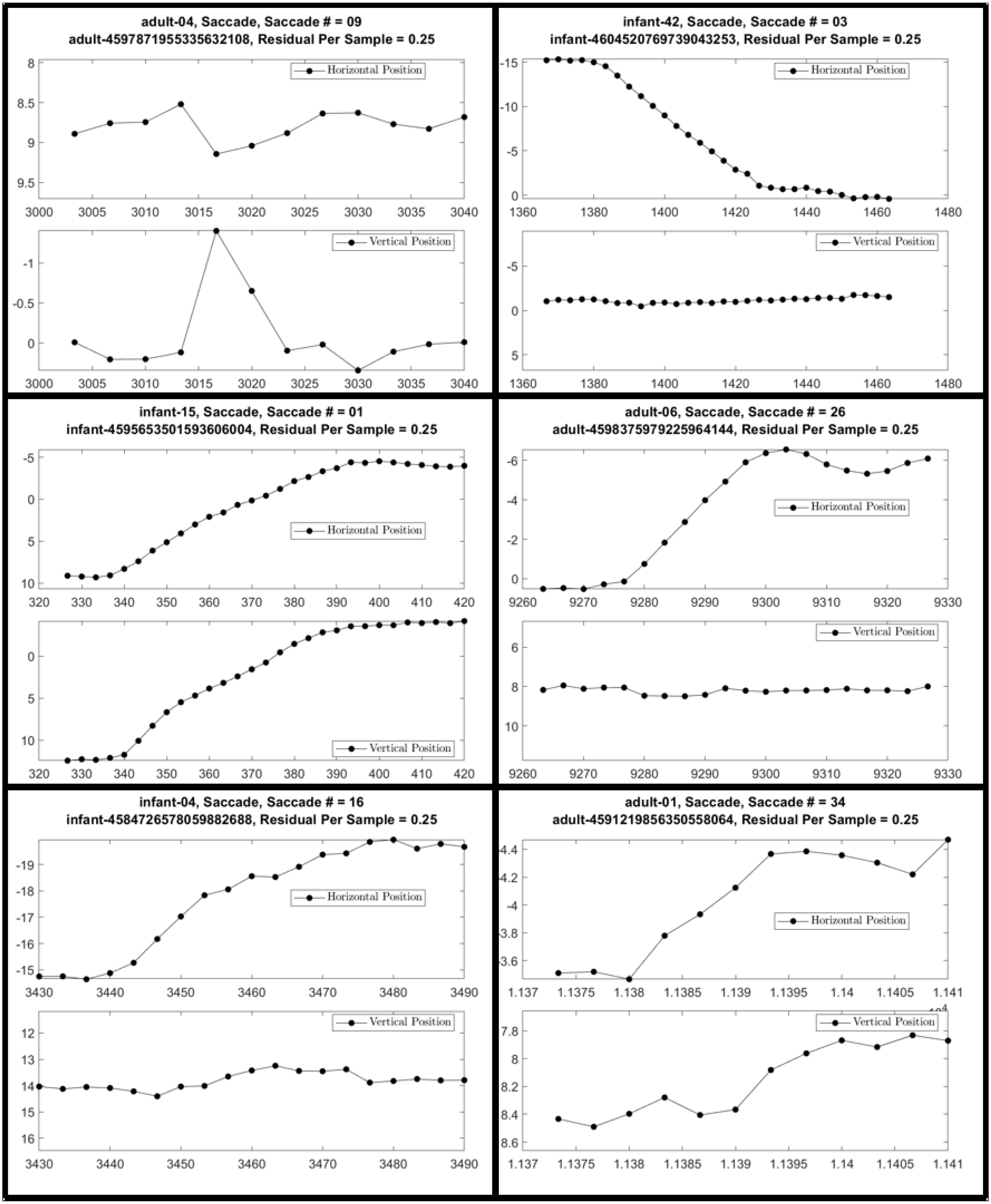

adult-05, Saccade, Saccade # = 15
adult-4598255842656666612, Residual Per Sample = 0.26
17
17.5
18
4640
4650
4660
4670
4680
4690
4700
Horizontal Position
-3.5
-3
-2.5
4640
4650
4660
4670
4680
4690
4700
Vertical Position
infant-49, Saccade, Saccade # = 06
infant-4605631479618949368, Residual Per Sample = 0.26
16
17
18
19
20
1820
1830
1840
1850
1860
1870
1880
Horizontal Position
10
11
12
13
14
1820
1830
1840
1850
1860
1870
1880
Vertical Position
adult-04, Saccade, Saccade # = 08
adult-4597871955335632108, Residual Per Sample = 0.26
9.4
9.6
9.8
10
10.2
2785
2790
2795
2800
2805
2810
2815
Horizontal Position
0
0.2
0.4
0.6
2785
2790
2795
2800
2805
2810
2815
Vertical Position
adult-04, Saccade, Saccade # = 41
adult-4597871955335632108, Residual Per Sample = 0.26
4.5
-14
3.5
-13
1.364
1.366
1.368
1.37
1.372
1.374
1.376
1.378
1.38
1.382
1.384
10⁴
Horizontal Position
-6
5.5
-5
4.5
1.364
1.366
1.368
1.37
1.372
1.374
1.376
1.378
1.38
1.382
1.384
Vertical Position
adult-05, Saccade, Saccade # = 26
adult-4598255842656666612, Residual Per Sample = 0.26
-0.5
0
0.5
9200
9205
9210
9215
9220
9225
9230
9235
9240
9245
Horizontal Position
-1
-0.5
0
9200
9205
9210
9215
9220
9225
9230
9235
9240
9245
Vertical Position
infant-48, Saccade, Saccade # = 05
infant-4605609553565853524, Residual Per Sample = 0.25
7
8
9
2775
2780
2785
2790
2795
2800
2805
2810
2815
2820
Horizontal Position
-5
-4
-3
2775
2780
2785
2790
2795
2800
2805
2810
2815
2820
Vertical Position

Figure 23:



adult-04, Saccade, Saccade # = 09
adult-4597871955335632108, Residual Per Sample = 0.25

infant-42, Saccade, Saccade # = 03
infant-4604520769739043253, Residual Per Sample = 0.25

infant-15, Saccade, Saccade # = 01
infant-4595653501593606004, Residual Per Sample = 0.25

adult-06, Saccade, Saccade # = 26
adult-4598375979225964144, Residual Per Sample = 0.25

infant-04, Saccade, Saccade # = 16
infant-4584726578059882688, Residual Per Sample = 0.25

adult-01, Saccade, Saccade # = 34
adult-4591219856350558064, Residual Per Sample = 0.25

Figure 24:

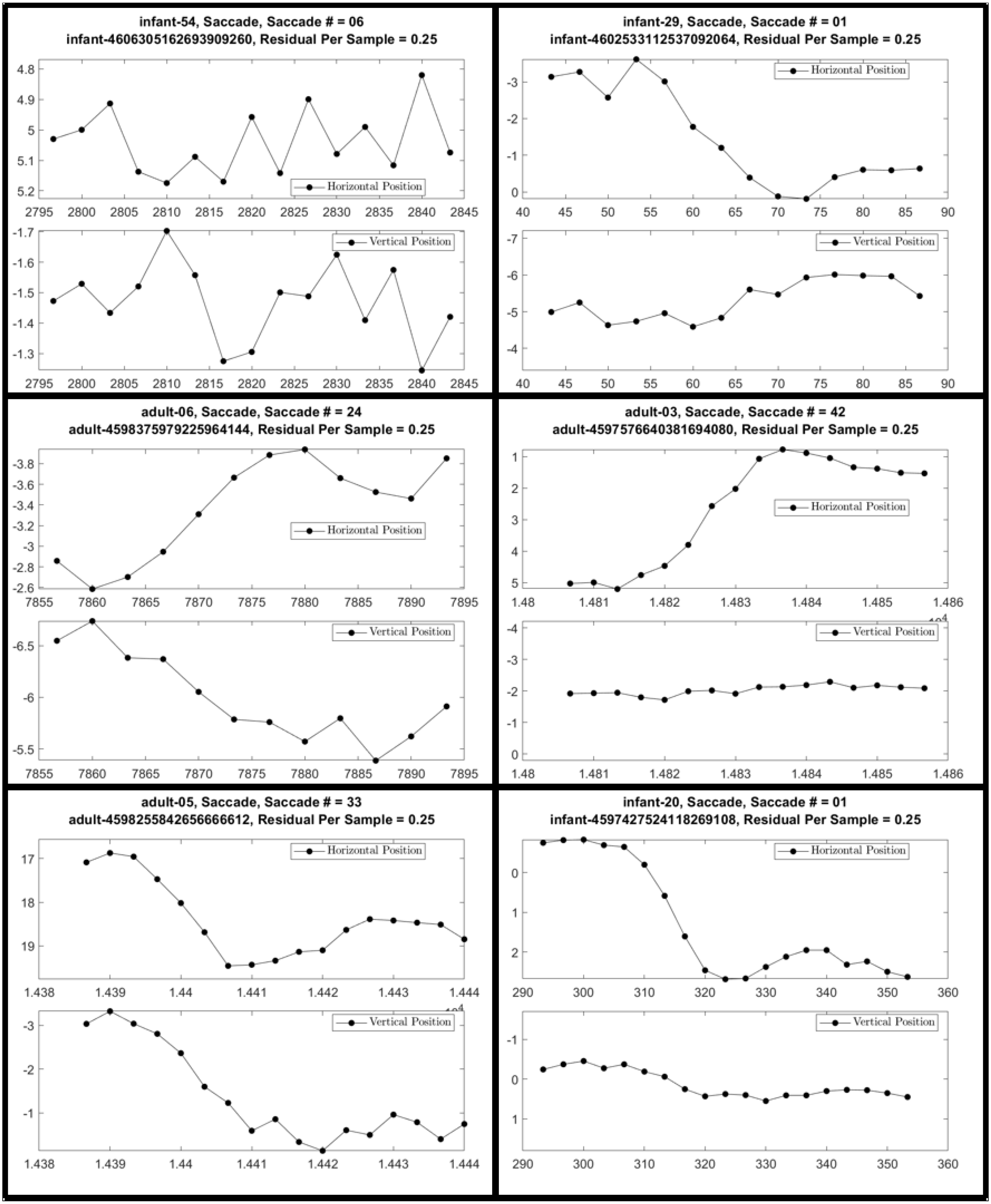

infant-54, Saccade, Saccade # = 06
infant-4606305162693909260, Residual Per Sample = 0.25
Horizontal Position
4.8
4.9
5
5.1
5.2
2795
2800
2805
2810
2815
2820
2825
2830
2835
2840
2845
Vertical Position
-1.7
-1.6
-1.5
-1.4
-1.3
infant-29, Saccade, Saccade # = 01
infant-4602533112537092064, Residual Per Sample = 0.25
Horizontal Position
-3
-2
-1
0
40
45
50
55
60
65
70
75
80
85
90
Vertical Position
-7
-6
-5
-4
adult-06, Saccade, Saccade # = 24
adult-4598375979225964144, Residual Per Sample = 0.25
Horizontal Position
-3.8
-3.6
-3.4
-3.2
-3
-2.8
-2.6
7855
7860
7865
7870
7875
7880
7885
7890
7895
Vertical Position
-6.5
-6
-5.5
adult-03, Saccade, Saccade # = 42
adult-4597576640381694080, Residual Per Sample = 0.25
Horizontal Position
1
2
3
4
5
1.48
1.481
1.482
1.483
1.484
1.485
1.486
$\times 10^4$
Vertical Position
-4
-3
-2
-1
0
adult-05, Saccade, Saccade # = 33
adult-4598255842656666612, Residual Per Sample = 0.25
Horizontal Position
17
18
19
1.438
1.439
1.44
1.441
1.442
1.443
1.444
$\times 10^4$
Vertical Position
-3
-2
-1
infant-20, Saccade, Saccade # = 01
infant-4597427524118269108, Residual Per Sample = 0.25
Horizontal Position
0
1
2
290
300
310
320
330
340
350
360
Vertical Position
-1
0
1

Figure 25:

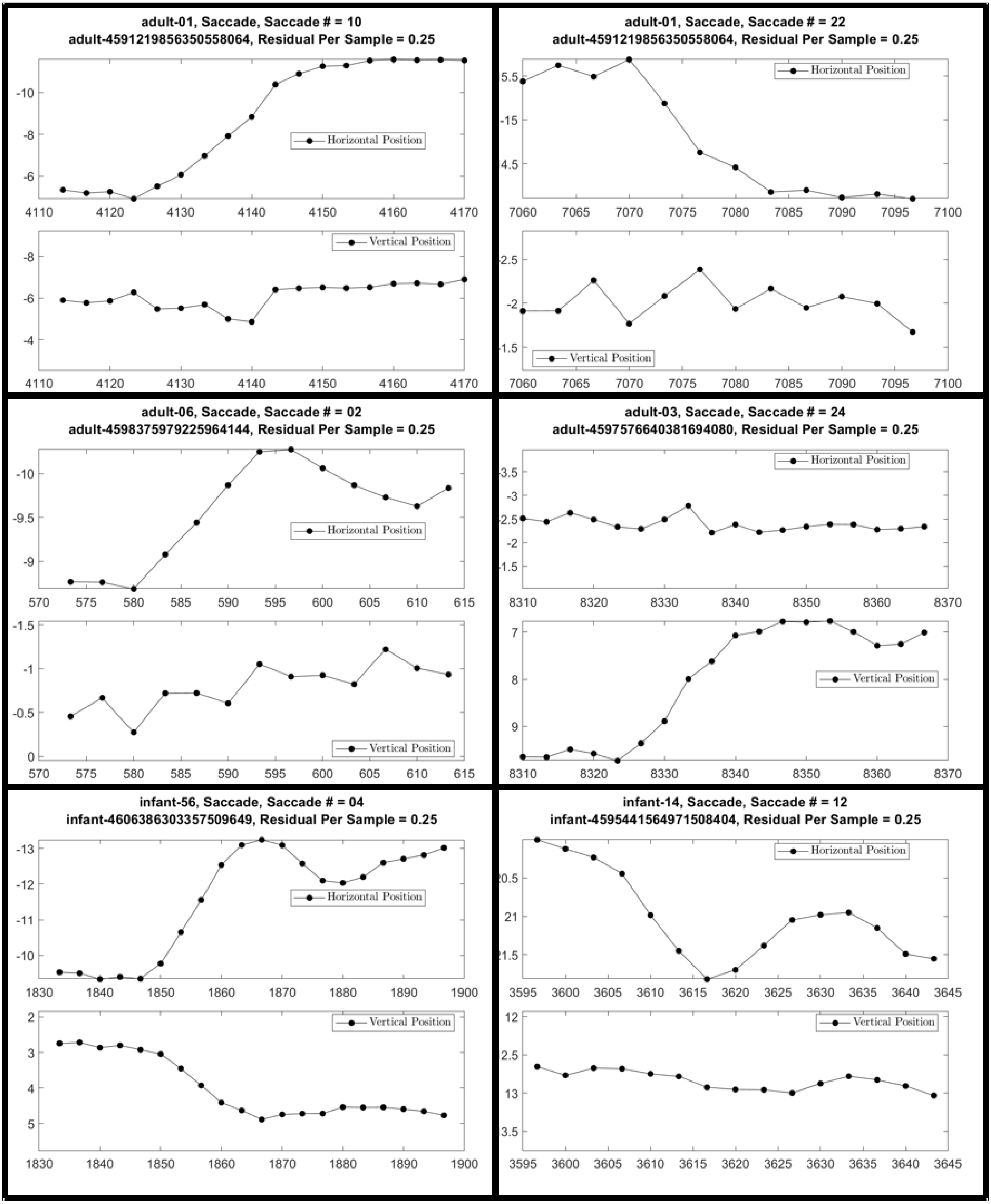

adult-01, Saccade, Saccade # = 10
adult-4591219856350558064, Residual Per Sample = 0.25
Horizontal Position
-10
-8
-6
4110
4120
4130
4140
4150
4160
4170
Vertical Position
-8
-6
-4
4110
4120
4130
4140
4150
4160
4170
adult-01, Saccade, Saccade # = 22
adult-4591219856350558064, Residual Per Sample = 0.25
Horizontal Position
5.5
-15
4.5
7060
7065
7070
7075
7080
7085
7090
7095
7100
Vertical Position
2.5
-2
1.5
7060
7065
7070
7075
7080
7085
7090
7095
7100
adult-06, Saccade, Saccade # = 02
adult-4598375979225964144, Residual Per Sample = 0.25
Horizontal Position
-10
-9.5
-9
570
575
580
585
590
595
600
605
610
615
Vertical Position
-1.5
-1
-0.5
0
570
575
580
585
590
595
600
605
610
615
adult-03, Saccade, Saccade # = 24
adult-4597576640381694080, Residual Per Sample = 0.25
Horizontal Position
3.5
-3
2.5
-2
1.5
8310
8320
8330
8340
8350
8360
8370
Vertical Position
7
8
9
8310
8320
8330
8340
8350
8360
8370
infant-56, Saccade, Saccade # = 04
infant-4606386303357509649, Residual Per Sample = 0.25
Horizontal Position
-13
-12
-11
-10
1830
1840
1850
1860
1870
1880
1890
1900
Vertical Position
2
3
4
5
1830
1840
1850
1860
1870
1880
1890
1900
infant-14, Saccade, Saccade # = 12
infant-4595441564971508404, Residual Per Sample = 0.25
Horizontal Position
20.5
21
1.5
3595
3600
3605
3610
3615
3620
3625
3630
3635
3640
3645
Vertical Position
12
2.5
13
3.5
3595
3600
3605
3610
3615
3620
3625
3630
3635
3640
3645

Figure 26:

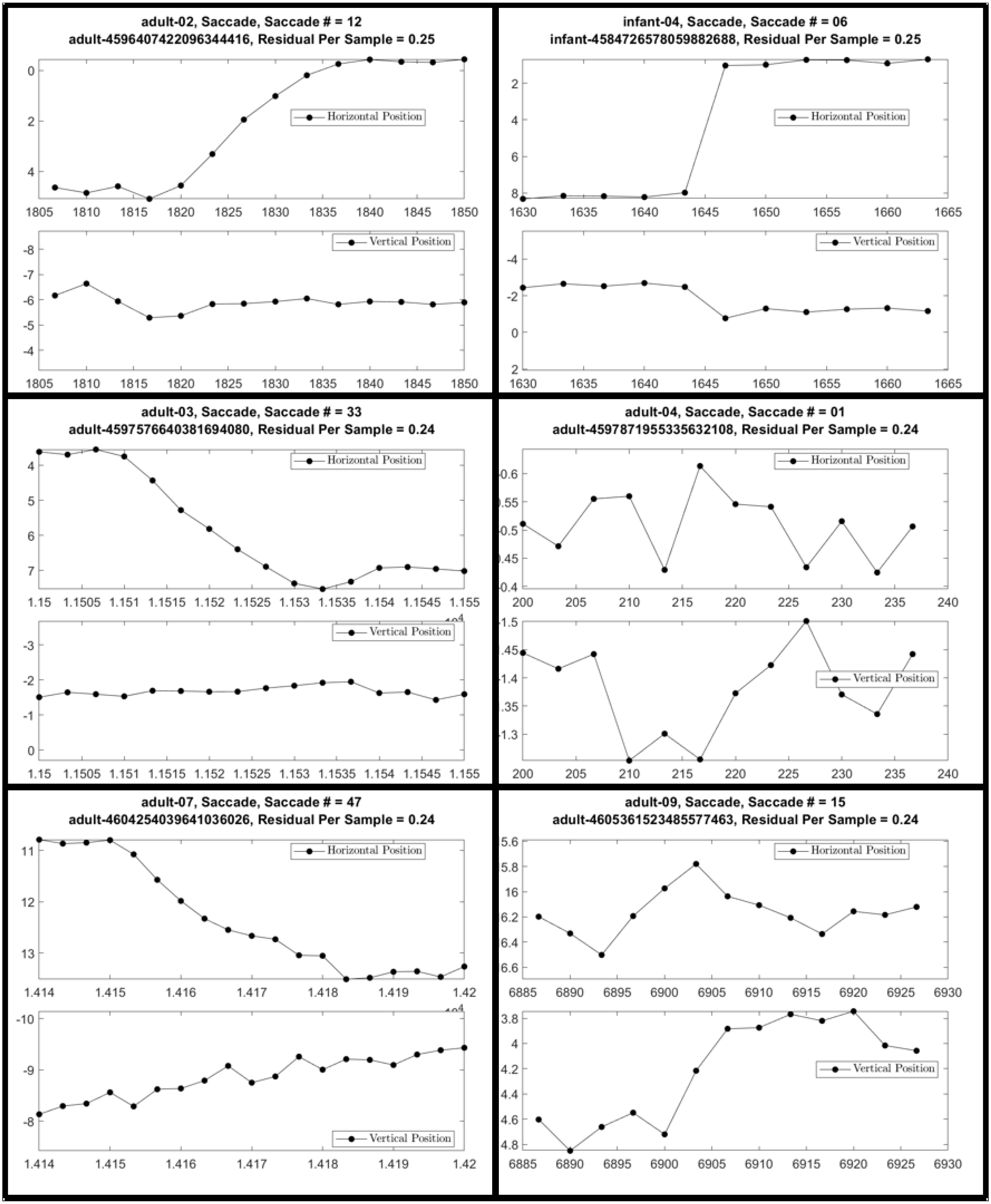

adult-02, Saccade, Saccade # = 12
adult-4596407422096344416, Residual Per Sample = 0.25
Horizontal Position
0
2
4
1805
1810
1815
1820
1825
1830
1835
1840
1845
1850
Vertical Position
-8
-7
-6
-5
-4
infant-04, Saccade, Saccade # = 06
infant-4584726578059882688, Residual Per Sample = 0.25
Horizontal Position
2
4
6
8
1630
1635
1640
1645
1650
1655
1660
1665
Vertical Position
-4
-2
0
2
adult-03, Saccade, Saccade # = 33
adult-4597576640381694080, Residual Per Sample = 0.24
Horizontal Position
4
5
6
7
1.15
1.1505
1.151
1.1515
1.152
1.1525
1.153
1.1535
1.154
1.1545
1.155
10^4
Vertical Position
-3
-2
-1
0
adult-04, Saccade, Saccade # = 01
adult-4597871955335632108, Residual Per Sample = 0.24
Horizontal Position
-0.6
0.55
-0.5
0.45
-0.4
200
205
210
215
220
225
230
235
240
Vertical Position
-1.5
.45
-1.4
.35
-1.3
adult-07, Saccade, Saccade # = 47
adult-4604254039641036026, Residual Per Sample = 0.24
Horizontal Position
11
12
13
1.414
1.415
1.416
1.417
1.418
1.419
1.42
10^4
Vertical Position
-10
-9
-8
adult-09, Saccade, Saccade # = 15
adult-4605361523485577463, Residual Per Sample = 0.24
Horizontal Position
5.6
5.8
16
6.2
6.4
6.6
6885
6890
6895
6900
6905
6910
6915
6920
6925
6930
Vertical Position
3.8
4
4.2
4.4
4.6
4.8

Figure 27:

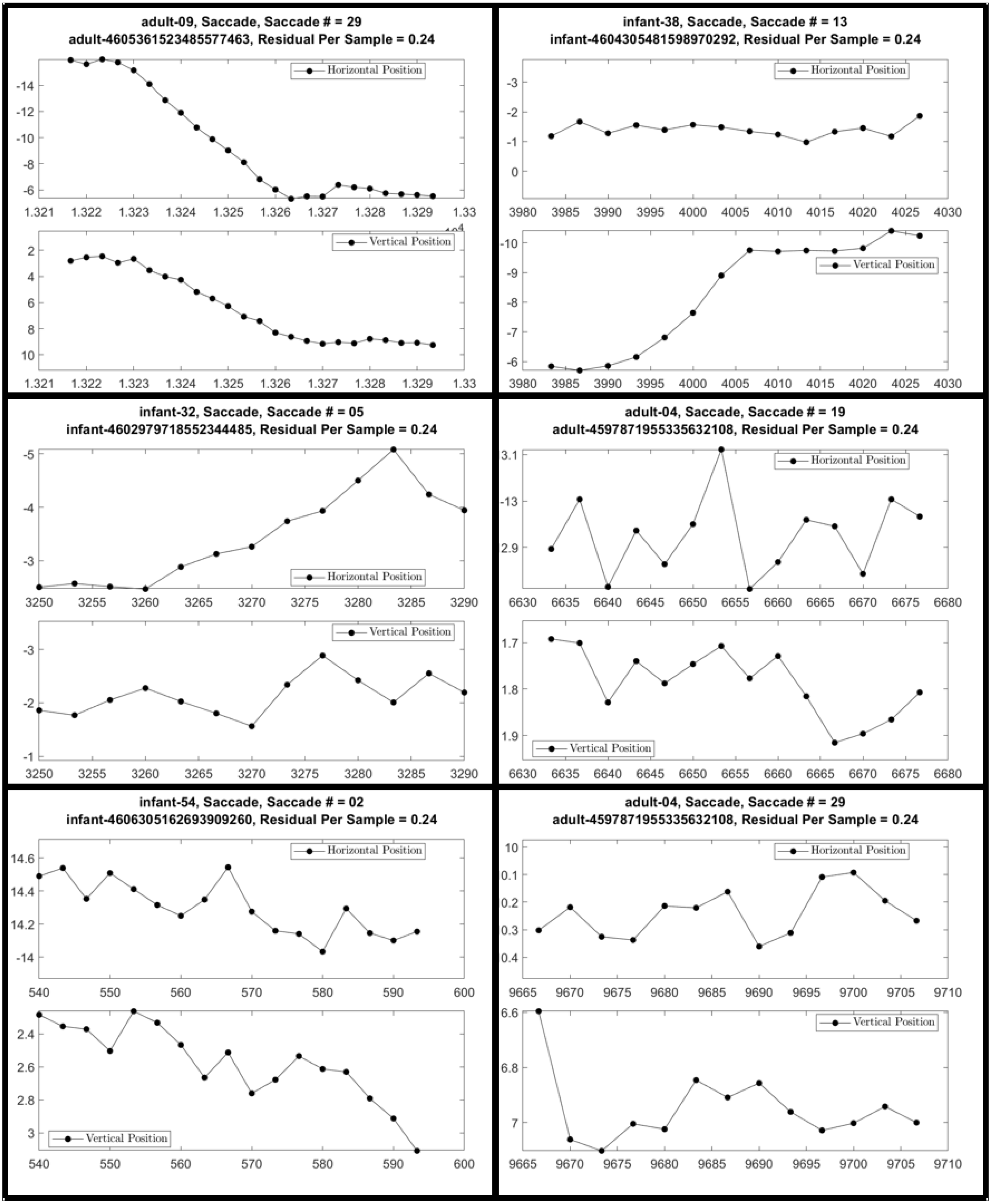

adult-09, Saccade, Saccade # = 29
adult-4605361523485577463, Residual Per Sample = 0.24
Horizontal Position
-14
-12
-10
-8
-6
1.321
1.322
1.323
1.324
1.325
1.326
1.327
1.328
1.329
1.33
10^4
Vertical Position
2
4
6
8
10
1.321
1.322
1.323
1.324
1.325
1.326
1.327
1.328
1.329
1.33
infant-38, Saccade, Saccade # = 13
infant-4604305481598970292, Residual Per Sample = 0.24
Horizontal Position
-3
-2
-1
0
3980
3985
3990
3995
4000
4005
4010
4015
4020
4025
4030
Vertical Position
-10
-9
-8
-7
-6
3980
3985
3990
3995
4000
4005
4010
4015
4020
4025
4030
infant-32, Saccade, Saccade # = 05
infant-4602979718552344485, Residual Per Sample = 0.24
Horizontal Position
-5
-4
-3
3250
3255
3260
3265
3270
3275
3280
3285
3290
Vertical Position
-3
-2
-1
3250
3255
3260
3265
3270
3275
3280
3285
3290
adult-04, Saccade, Saccade # = 19
adult-4597871955335632108, Residual Per Sample = 0.24
Horizontal Position
3.1
-13
2.9
6630
6635
6640
6645
6650
6655
6660
6665
6670
6675
6680
Vertical Position
1.7
1.8
1.9
6630
6635
6640
6645
6650
6655
6660
6665
6670
6675
6680
infant-54, Saccade, Saccade # = 02
infant-4606305162693909260, Residual Per Sample = 0.24
Horizontal Position
14.6
14.4
14.2
-14
540
550
560
570
580
590
600
Vertical Position
2.4
2.6
2.8
3
540
550
560
570
580
590
600
adult-04, Saccade, Saccade # = 29
adult-4597871955335632108, Residual Per Sample = 0.24
Horizontal Position
10
0.1
0.2
0.3
0.4
9665
9670
9675
9680
9685
9690
9695
9700
9705
9710
Vertical Position
6.6
6.8
7
9665
9670
9675
9680
9685
9690
9695
9700
9705
9710

Figure 28:

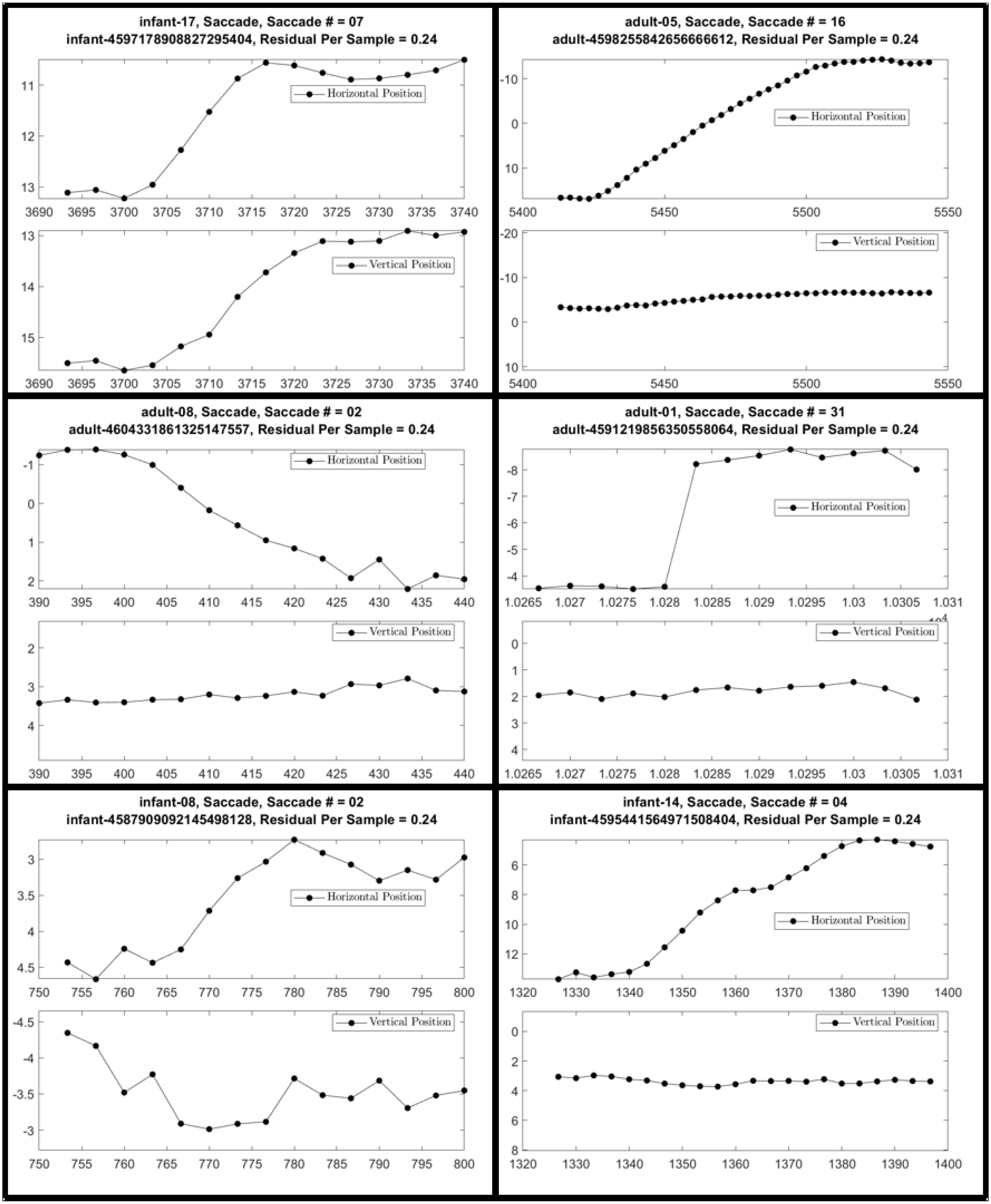

infant-17, Saccade, Saccade # = 07
infant-4597178908827295404, Residual Per Sample = 0.24
Horizontal Position
11
12
13
3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740
Vertical Position
13
14
15
3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740
adult-05, Saccade, Saccade # = 16
adult-4598255842656666612, Residual Per Sample = 0.24
Horizontal Position
-10
0
10
5400 5450 5500 5550
Vertical Position
-20
-10
0
10
5400 5450 5500 5550
adult-08, Saccade, Saccade # = 02
adult-4604331861325147557, Residual Per Sample = 0.24
Horizontal Position
-1
0
1
2
390 395 400 405 410 415 420 425 430 435 440
Vertical Position
2
3
4
390 395 400 405 410 415 420 425 430 435 440
adult-01, Saccade, Saccade # = 31
adult-4591219856350558064, Residual Per Sample = 0.24
Horizontal Position
-8
-7
-6
-5
-4
1.0265 1.027 1.0275 1.028 1.0285 1.029 1.0295 1.03 1.0305 1.031
Vertical Position
0
1
2
3
4
1.0265 1.027 1.0275 1.028 1.0285 1.029 1.0295 1.03 1.0305 1.031
infant-08, Saccade, Saccade # = 02
infant-4587909092145498128, Residual Per Sample = 0.24
Horizontal Position
3
3.5
4
4.5
750 755 760 765 770 775 780 785 790 795 800
Vertical Position
-4.5
-4
-3.5
-3
750 755 760 765 770 775 780 785 790 795 800
infant-14, Saccade, Saccade # = 04
infant-4595441564971508404, Residual Per Sample = 0.24
Horizontal Position
6
8
10
12
1320 1330 1340 1350 1360 1370 1380 1390 1400
Vertical Position
0
2
4
6
8
1320 1330 1340 1350 1360 1370 1380 1390 1400

Figure 29:

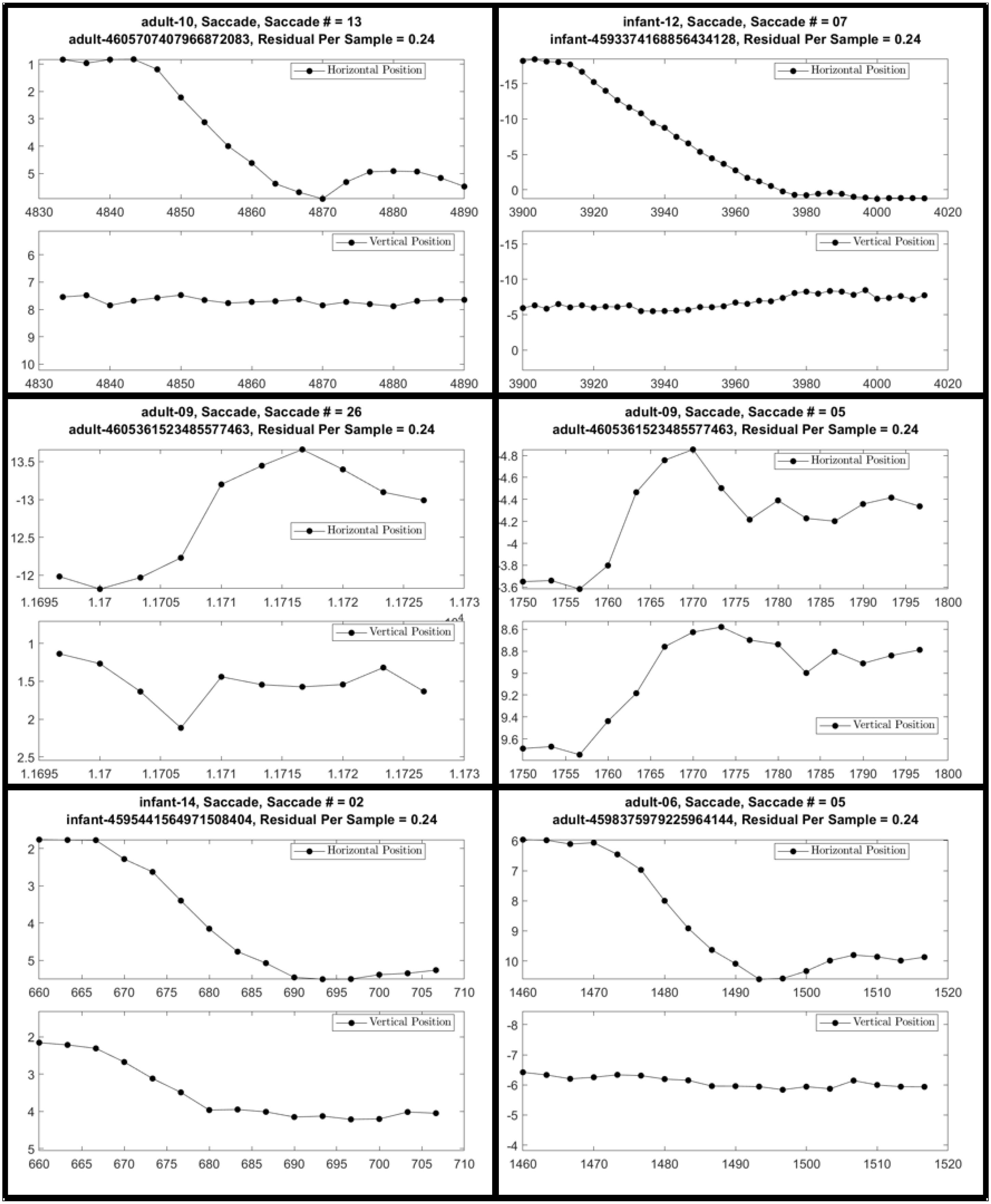

adult-10, Saccade, Saccade # = 13
adult-4605707407966872083, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
1
2
3
4
5
6
7
8
9
10
4830
4840
4850
4860
4870
4880
4890
infant-12, Saccade, Saccade # = 07
infant-4593374168856434128, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
-15
-10
-5
0
3900
3920
3940
3960
3980
4000
4020
adult-09, Saccade, Saccade # = 26
adult-4605361523485577463, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
13.5
-13
12.5
-12
1
1.5
2
2.5
1.1695
1.17
1.1705
1.171
1.1715
1.172
1.1725
1.173
10^4
adult-09, Saccade, Saccade # = 05
adult-4605361523485577463, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
4.8
4.6
4.4
4.2
-4
3.8
3.6
8.6
8.8
9
9.2
9.4
9.6
1750
1755
1760
1765
1770
1775
1780
1785
1790
1795
1800
infant-14, Saccade, Saccade # = 02
infant-4595441564971508404, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
2
3
4
5
660
665
670
675
680
685
690
695
700
705
710
adult-06, Saccade, Saccade # = 05
adult-4598375979225964144, Residual Per Sample = 0.24
Horizontal Position
Vertical Position
6
7
8
9
10
-8
-7
-6
-5
-4
1460
1470
1480
1490
1500
1510
1520

Figure 30:

7 Discussion

If the humanFixationEvaluation datset is processed according to the description found in the gazeNet paper, there are 929 potential saccades to be classified by an automatic algorithm for fixation rater MN. Of these, 332 or 36% of potential saccades were either preceded or followed by NaNs and are therefore are actually blink-saccades and not saccades. There are at least 162 saccades, and probably substantially more, that are very ill-formed. Some of these ill-formed potential saccades include well-formed saccades but either start too early or end too late. No trained and skilled human rater would consider these events to be properly identified saccades. Treating them as ground truth for saccades is insane. These events account for of a total 27% of 597 non-blink saccades. So, if we consider the total number of non-saccade events considered as saccades by gazeNet [1] (332+162) the total accounts for 36% of all potential saccades.

It would appear that if you wanted an algorithm to misclassify blink-saccades and ill-formed saccades as saccades that gazeNet is your algorithm. If you want to only identify true saccades as saccades it would probably be best to look for a superior algorithm.

References

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