## Appendix C. Detailed segmentation statistics.

The tables is this appendix show distribution statistics, by finger position, for the segmentation algorithms tested as compared to the hand marked ground truth for 3-inch slap images. The differences between the segmentation algorithm and ground truth are sorted into bins based on the tolerances allowed for correct segmentation. Specifically, the left/right edges must be within -32/+64 pixels of the ground truth, top edge -64/+64 and bottom edge -64/+128. For each finger position there is a column for each of the four segmentation box edges (L, R, T and B).

The first row ("No Finger Found") shows the counts for when a finger was not detected by the segmentation algorithm. The next four rows show statistics for segmentation edges that are within the specified minimum (MN) and maximum (MX) pixel tolerances compared to the ground truth, so these are considered good segmentations. Rows 1 (MN <= d < 0) and 3 (0 <= d <= MX) show the average value for all differences in that range and rows 3 and 5 show the total count occurring in that range.

Rows 6-9 also show average difference values and bin counts but for ranges MN-32 <= d < MN and MX < d <= MX+32, which are just outside the accepted tolerance ranges. Rows 10-13 tally everything greater than 32 pixels away from the accepted tolerance range, d < MN-32 and d > MX+32.

The last three rows show the total count for each bin, the overall average difference value and the standard deviation of all the difference values.

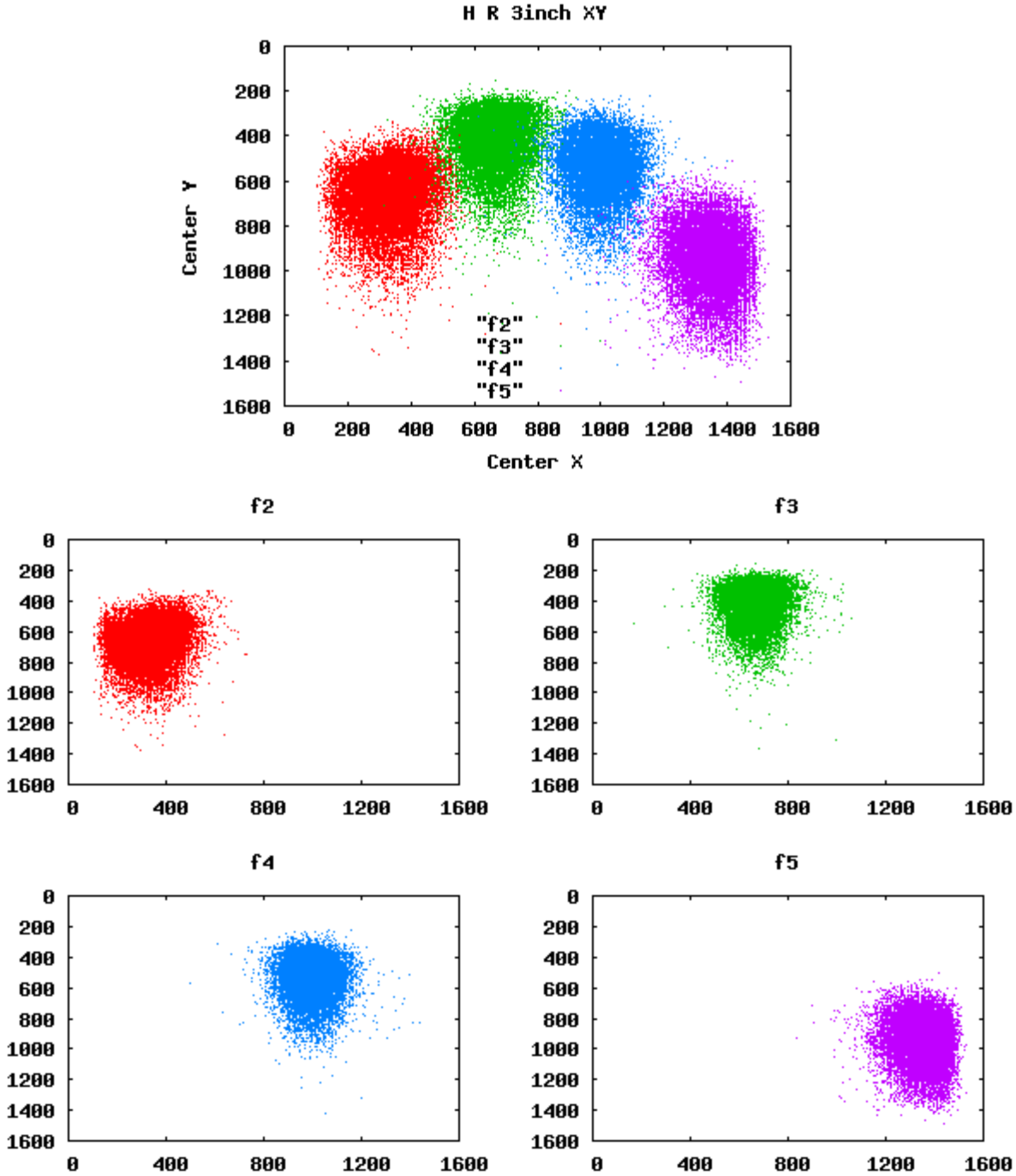
# H

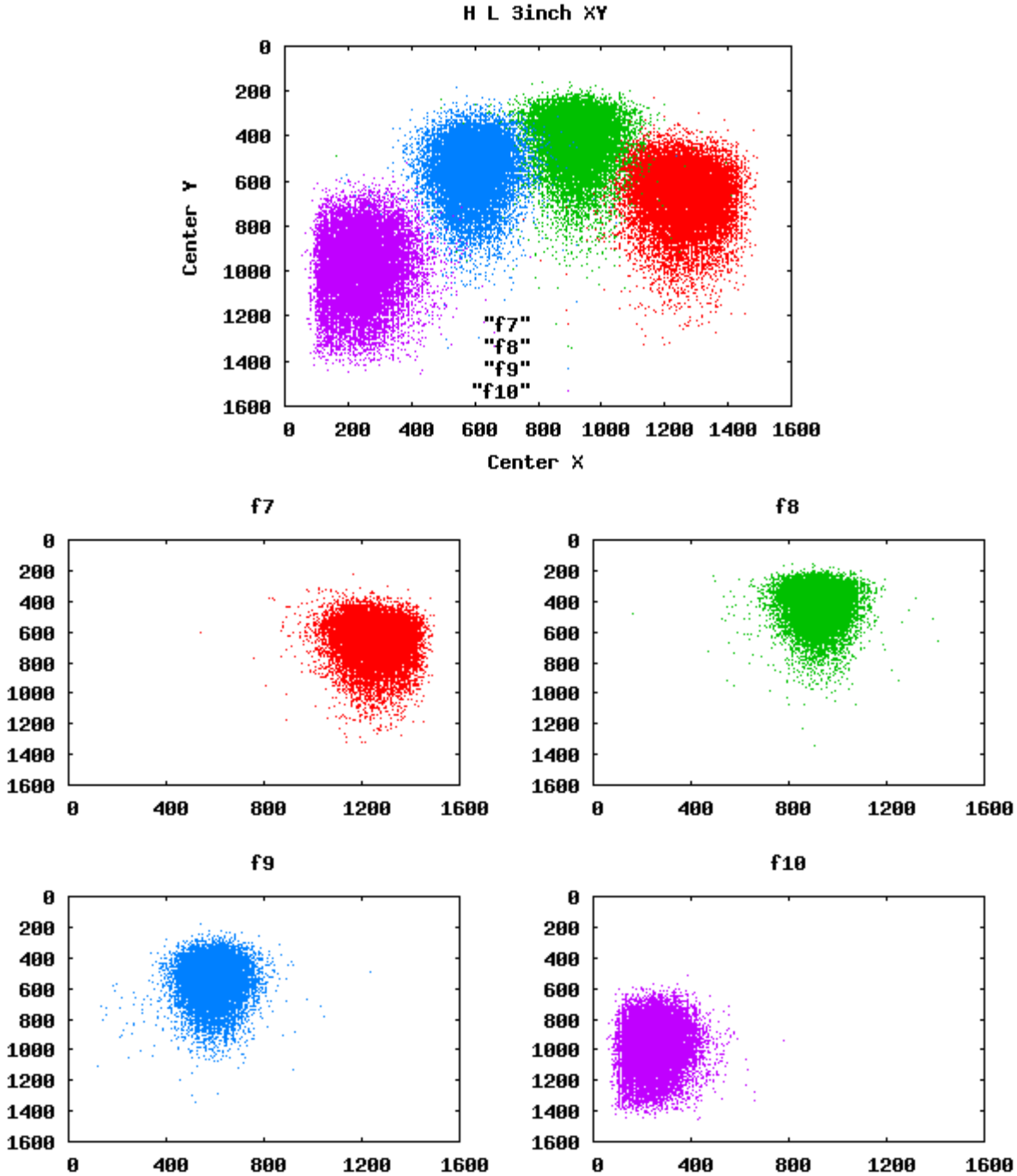
| | R. Thumb | | | | R. Index | | | | R Middle | | | | R. Ring | | | | R. Little | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No Finger Found | 4129 | | | | 44 | | | | 23 | | | | 25 | | | | 331 | | | |
| | L | R | T | B | L | R | T | B | L | R | T | B | L | R | T | B | L | R | T | B |
| MN <= d < 0 | -6.85 | -9.71 | -12.28 | -22.98 | -4.32 | -5.28 | -8.59 | -22.45 | -5.53 | -5.18 | -8.65 | -29.99 | -4.04 | -6.90 | -8.03 | -31.78 | -4.24 | -6.93 | -7.79 | -23.11 |
| # | 2677 | 5766 | 2924 | 1509 | 11959 | 1737 | 14338 | 539 | 13558 | 3947 | 13875 | 705 | 4492 | 6018 | 12800 | 458 | 2580 | 5981 | 6246 | 450 |
| 0 <= d <= MX | 15.67 | 12.76 | 21.00 | 36.93 | 9.14 | 16.59 | 12.20 | 43.29 | 8.41 | 13.77 | 12.83 | 47.78 | 12.11 | 11.66 | 13.00 | 49.06 | 13.91 | 11.84 | 15.50 | 46.75 |
| # | 17541 | 13974 | 17049 | 17810 | 12839 | 23095 | 10479 | 24099 | 11222 | 20892 | 10986 | 23820 | 20372 | 18724 | 12056 | 23978 | 21861 | 18365 | 18218 | 23672 |
| MN-32 <= d < MN | -42.24 | -41.44 | -77.29 | -78.59 | -39.21 | -42.02 | -75.93 | -78.99 | -38.01 | -39.03 | -74.56 | -78.09 | -39.18 | -38.44 | -75.95 | -78.98 | -42.50 | -40.06 | -79.29 | -76.76 |
| # | 65 | 457 | 98 | 308 | 87 | 27 | 28 | 78 | 112 | 48 | 34 | 160 | 31 | 157 | 28 | 149 | 54 | 211 | 34 | 66 |
| MX < d <= MX+32 | #DIV/0! | 74.10 | 67.95 | 142.04 | 77.67 | 75.75 | 73.25 | 136.17 | #DIV/0! | 82.00 | 77.17 | 142.19 | 88.00 | #DIV/0! | 77.75 | 142.42 | 78.00 | 76.38 | 69.30 | 142.12 |
| # | 0 | 10 | 11 | 141 | 6 | 4 | 4 | 24 | 0 | 2 | 9 | 85 | 2 | 0 | 4 | 104 | 1 | 34 | 10 | 65 |
| d < MN-32 | -137.11 | -1397.95 | -175.14 | -1296.79 | -294.76 | -293.76 | -420.48 | -373.73 | -327.85 | -628.08 | -300.00 | -197.38 | -322.09 | -907.32 | -317.70 | -215.84 | -136.71 | -1341.71 | -281.20 | -858.37 |
| # | 18 | 4209 | 218 | 4498 | 61 | 50 | 23 | 185 | 53 | 24 | 38 | 142 | 45 | 25 | 64 | 133 | 58 | 362 | 128 | 376 |
| d > MX+32 | 1034.46 | 259.67 | 881.06 | 224.07 | 201.25 | 377.99 | 436.97 | 426.63 | 429.13 | 346.15 | 193.27 | 339.56 | 683.87 | 342.44 | 351.63 | 267.85 | 1014.09 | 273.37 | 594.57 | 312.20 |
| # | 4121 | 6 | 4122 | 156 | 16 | 55 | 96 | 43 | 23 | 55 | 26 | 56 | 26 | 44 | 16 | 146 | 414 | 15 | 332 | 339 |
| Total # | 24422 | 24422 | 24422 | 24422 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 | 24968 |
| Average | 184.84 | -236.60 | 160.06 | -212.07 | 1.92 | 15.19 | 1.40 | 39.15 | 0.31 | 10.80 | 0.51 | 44.36 | 9.24 | 6.54 | 1.50 | 47.07 | 28.15 | -12.47 | 15.75 | 35.39 |
| Std Dev | 384.70 | 537.44 | 332.79 | 540.17 | 18.88 | 25.52 | 35.75 | 53.59 | 22.88 | 28.98 | 20.81 | 36.49 | 29.18 | 36.47 | 25.34 | 39.84 | 140.50 | 169.68 | 76.32 | 125.24 |

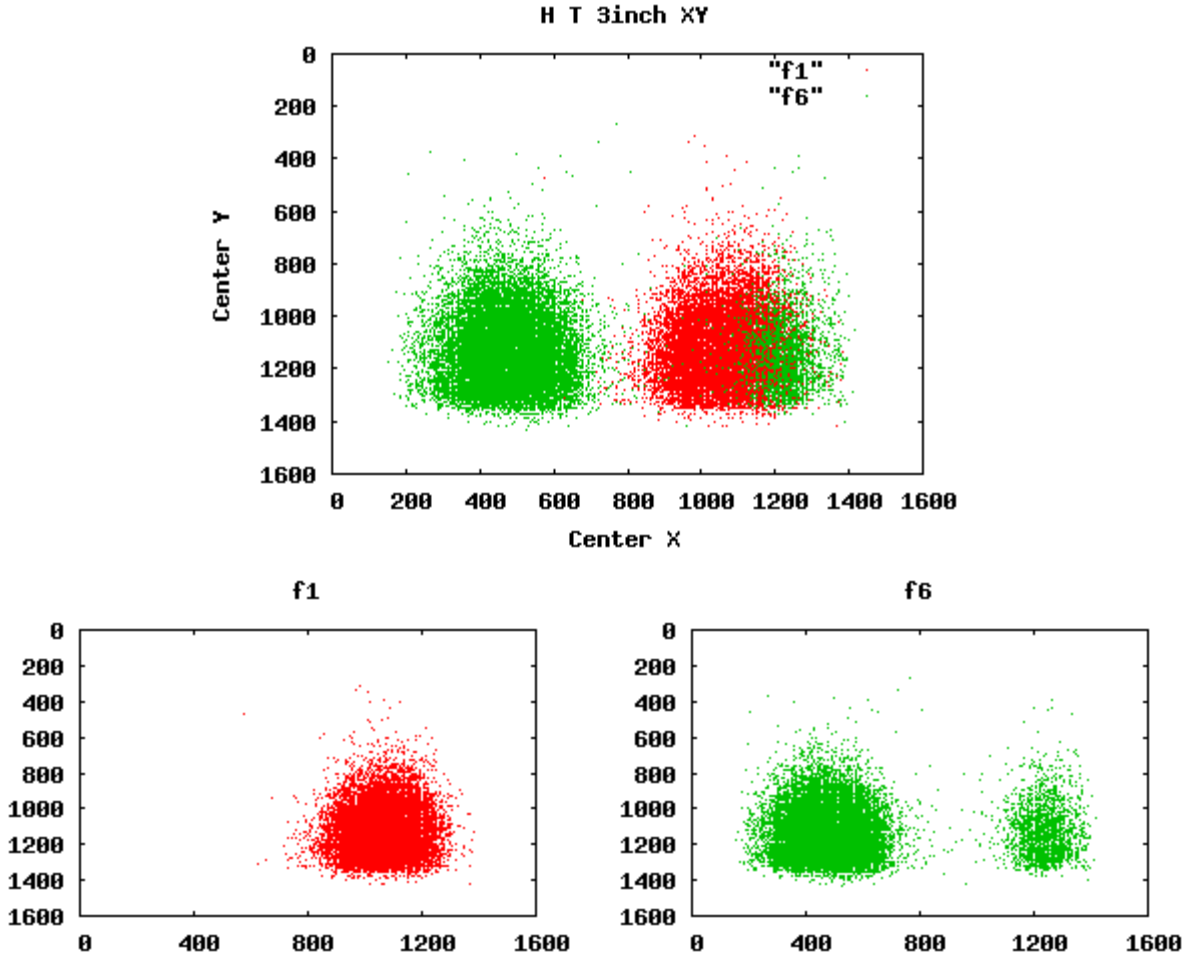
| | L. Thumb | | | | L. Index | | | | L. Middle | | | | L. Ring | | | | L. Little | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No Finger Found | 251 | | | | 67 | | | | 24 | | | | 17 | | | | 494 | | | |
| | L | R | T | B | L | R | T | B | L | R | T | B | L | R | T | B | L | R | T | B |
| MN <= d < 0 | -9.27 | -7.34 | -12.43 | -20.91 | -2.95 | -6.98 | -8.37 | -22.54 | -4.78 | -6.19 | -8.89 | -29.61 | -4.56 | -6.60 | -7.82 | -29.05 | -5.84 | -7.48 | -8.23 | -22.26 |
| # | 6436 | 2157 | 3651 | 2344 | 4611 | 5082 | 13715 | 489 | 8146 | 5734 | 13545 | 768 | 10527 | 1951 | 11817 | 491 | 10273 | 1280 | 5486 | 558 |
| 0 <= d <= MX | 11.26 | 17.73 | 21.24 | 34.33 | 12.64 | 12.81 | 12.94 | 42.76 | 11.39 | 11.59 | 13.10 | 46.11 | 10.24 | 17.27 | 14.26 | 44.84 | 11.31 | 20.52 | 17.02 | 42.96 |
| # | 14954 | 19653 | 19455 | 20364 | 20175 | 19594 | 11045 | 24086 | 16669 | 19077 | 11294 | 23657 | 14286 | 22907 | 12996 | 23837 | 13922 | 22901 | 18643 | 23129 |
| MN-32 <= d < MN | -42.64 | -43.74 | -77.33 | -78.11 | -40.95 | -39.75 | -75.02 | -77.40 | -37.91 | -38.60 | -77.24 | -76.85 | -37.41 | -40.20 | -75.39 | -79.70 | -40.47 | -44.36 | -78.59 | -79.67 |
| # | 447 | 80 | 101 | 319 | 38 | 175 | 25 | 77 | 66 | 73 | 27 | 213 | 63 | 28 | 19 | 174 | 186 | 88 | 54 | 92 |
| MX < d <= MX+32 | 76.71 | #DIV/0! | 79.08 | 143.48 | 86.50 | 87.50 | 77.06 | 140.94 | 77.58 | 81.00 | 84.13 | 140.74 | 83.50 | 94.00 | #DIV/0! | 143.77 | 77.85 | 78.83 | 64.83 | 144.19 |
| # | 42 | 0 | 401 | 235 | 1 | 2 | 9 | 25 | 6 | 2 | 8 | 54 | 9 | 1 | 0 | 100 | 124 | 3 | 3 | 68 |
| d < MN-32 | -849.22 | -530.32 | -223.72 | -556.32 | -103.32 | -884.32 | -255.77 | -376.37 | -422.00 | -540.39 | -319.73 | -186.94 | -292.47 | -358.36 | -316.60 | -170.77 | -156.46 | -333.34 | -293.13 | -859.63 |
| # | 2348 | 277 | 132 | 919 | 31 | 110 | 37 | 234 | 14 | 66 | 63 | 187 | 17 | 65 | 116 | 172 | 56 | 606 | 288 | 571 |
| d > MX+32 | 258.01 | 915.68 | 518.02 | 280.35 | 781.64 | 110.50 | 379.78 | 339.35 | 487.56 | 611.08 | 182.46 | 382.45 | 329.89 | 434.54 | 347.69 | 309.84 | 187.08 | 227.10 | 613.32 | 339.46 |
| # | 195 | 2255 | 682 | 241 | 108 | 1 | 133 | 53 | 63 | 12 | 27 | 85 | 62 | 12 | 16 | 190 | 403 | 86 | 490 | 546 |
| Total # | 24422 | 24422 | 24422 | 24422 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 | 24964 |
| Average | -75.78 | 92.01 | 29.30 | 8.81 | 12.87 | 4.47 | 2.72 | 37.91 | 6.96 | 6.19 | 0.44 | 42.34 | 4.49 | 14.56 | 2.42 | 43.44 | 6.66 | 10.99 | 19.40 | 27.16 |
| Std Dev | 259.87 | 271.54 | 120.66 | 170.04 | 58.87 | 71.11 | 35.39 | 56.16 | 31.91 | 39.47 | 23.75 | 40.58 | 22.03 | 26.41 | 29.69 | 41.89 | 29.29 | 61.14 | 95.71 | 154.03 |

## Appendix D. Plots of 3-inch segmentation box centers.

The plots in this appendix show the distribution of the segmentation box centers (x,y) for the 3-inch data. There is a combined plot for each slap image and then a smaller plot for each finger position. The individual finger plots are better for seeing the full “spread” of x,y positions detected. The plot for the ground truth (GT) is included as a baseline for comparison. The blank lines that appear in some of the plots are most likely caused by the segmentation algorithm doing some level of sampling of the input image. The reason the lines are not evenly distributed in some plots is an artifact of the sampling when scaling the images for displaying in the report.

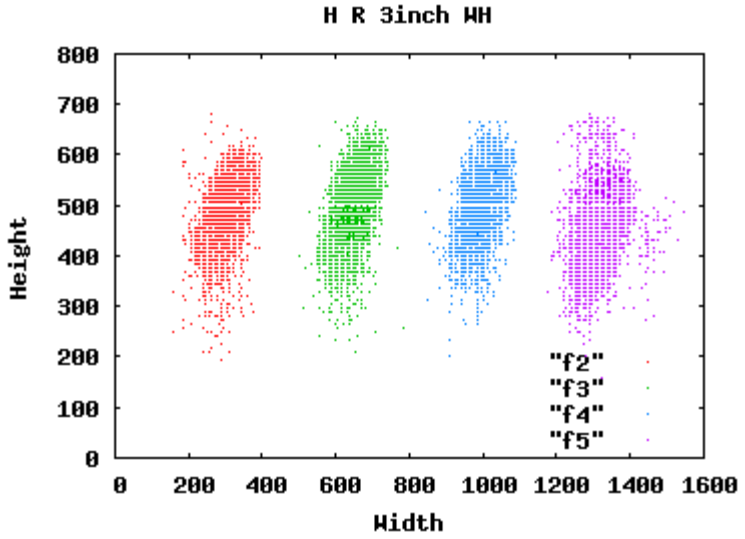

H R 3inch XY
Center Y
Center X
"f2"
"f3"
"f4"
"f5"
f2
f3
f4
f5

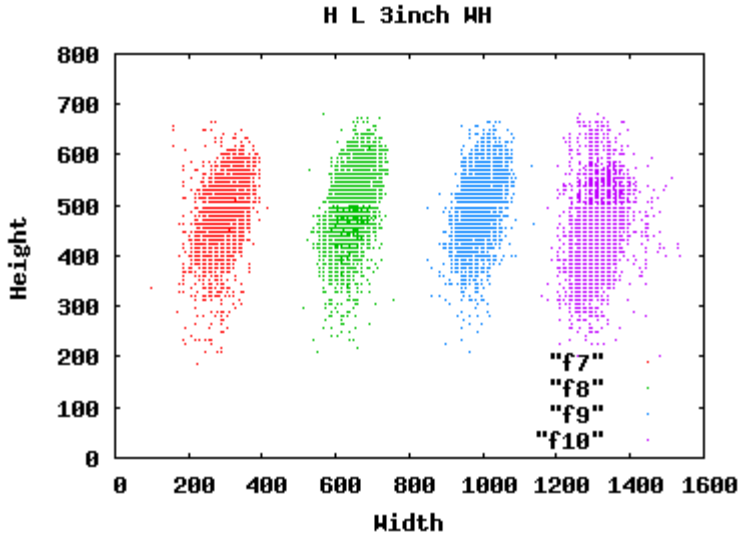

H L 3inch XY
Center Y
Center X
"f7"
"f8"
"f9"
"f10"
f7
f8
f9
f10

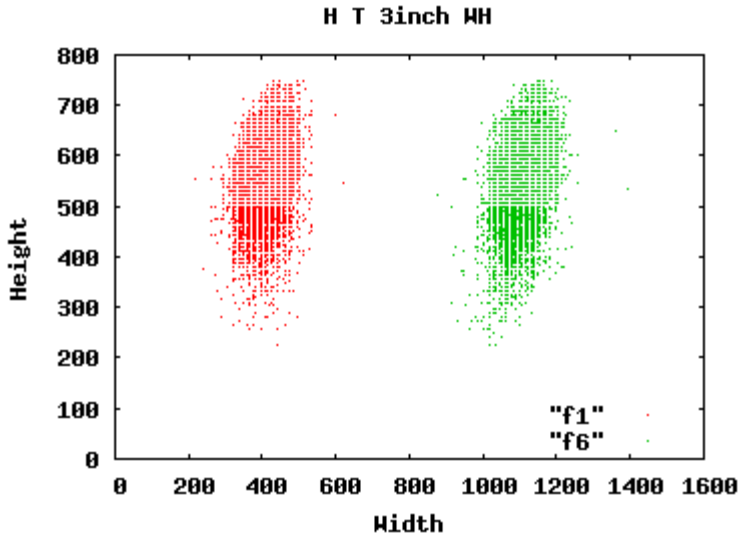

H T 3inch XY
"f1"
"f6"
Center Y
Center X
0
200
400
600
800
1000
1200
1400
1600
f1
f6

## Appendix E. Plots of 3-inch segmentation box widths and heights.

The plots in this appendix show the distribution of the segmentation box widths and heights for the 3-inch data. There is a combined plot for each slap image and then a smaller plot for each finger position. The individual finger plots are better for seeing the full “spread” of widths and heights detected. The widths are “spread out” on the plot by adding 350, 750 and 1050 to the 2$^{nd}$, 3$^{rd}$, and 4$^{th}$ widths plotted. The plot for the ground truth (GT) is included as a baseline for comparison. The blank lines that appear in some of the plots are most likely caused by the segmentation algorithm doing some level of sampling of the input image. The reason the lines are not evenly distributed in some plots is an artifact of the sampling when scaling the images for displaying in the report.

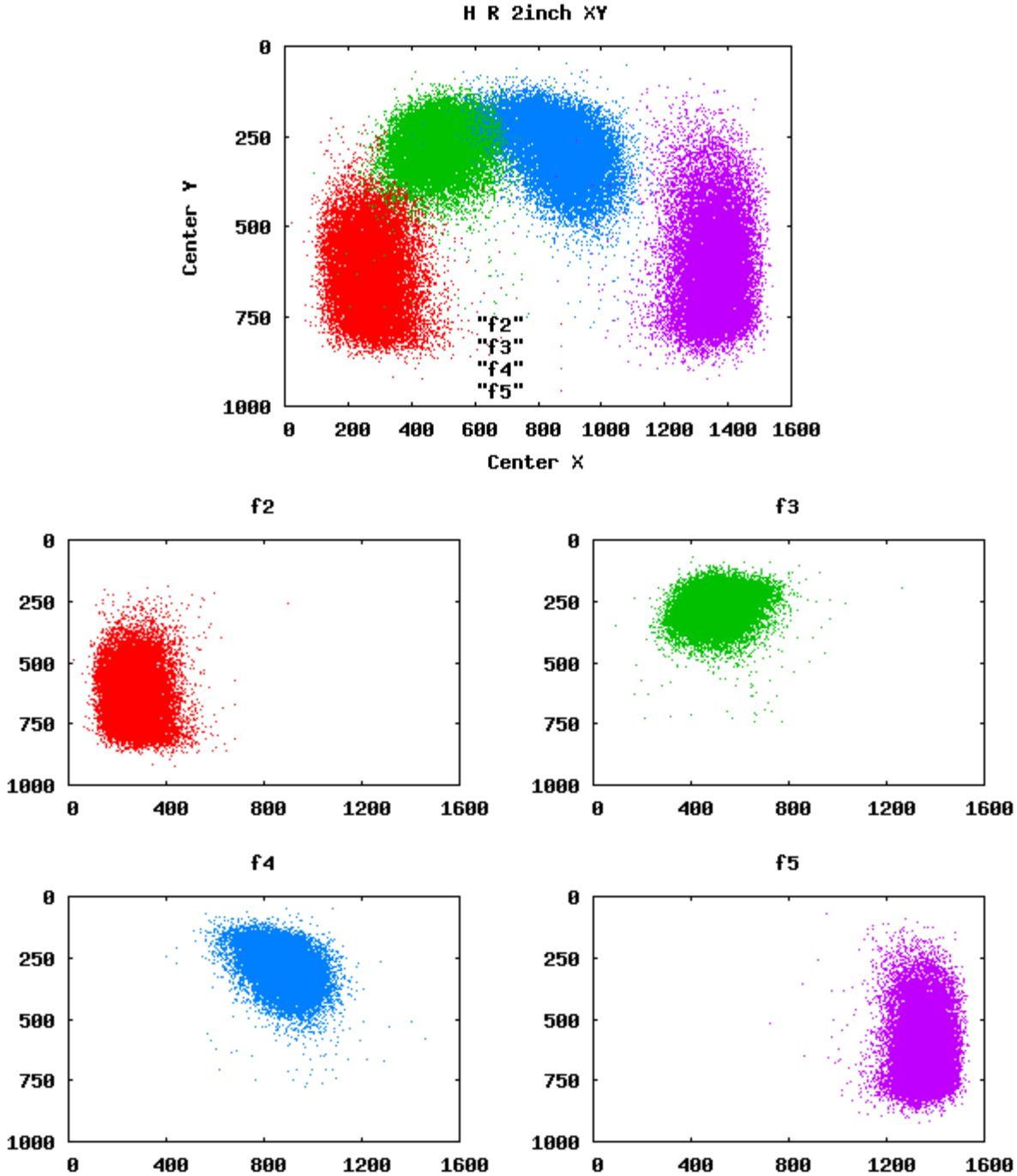

H R 3inch WH
Height
Width
"f2"
"f3"
"f4"
"f5"

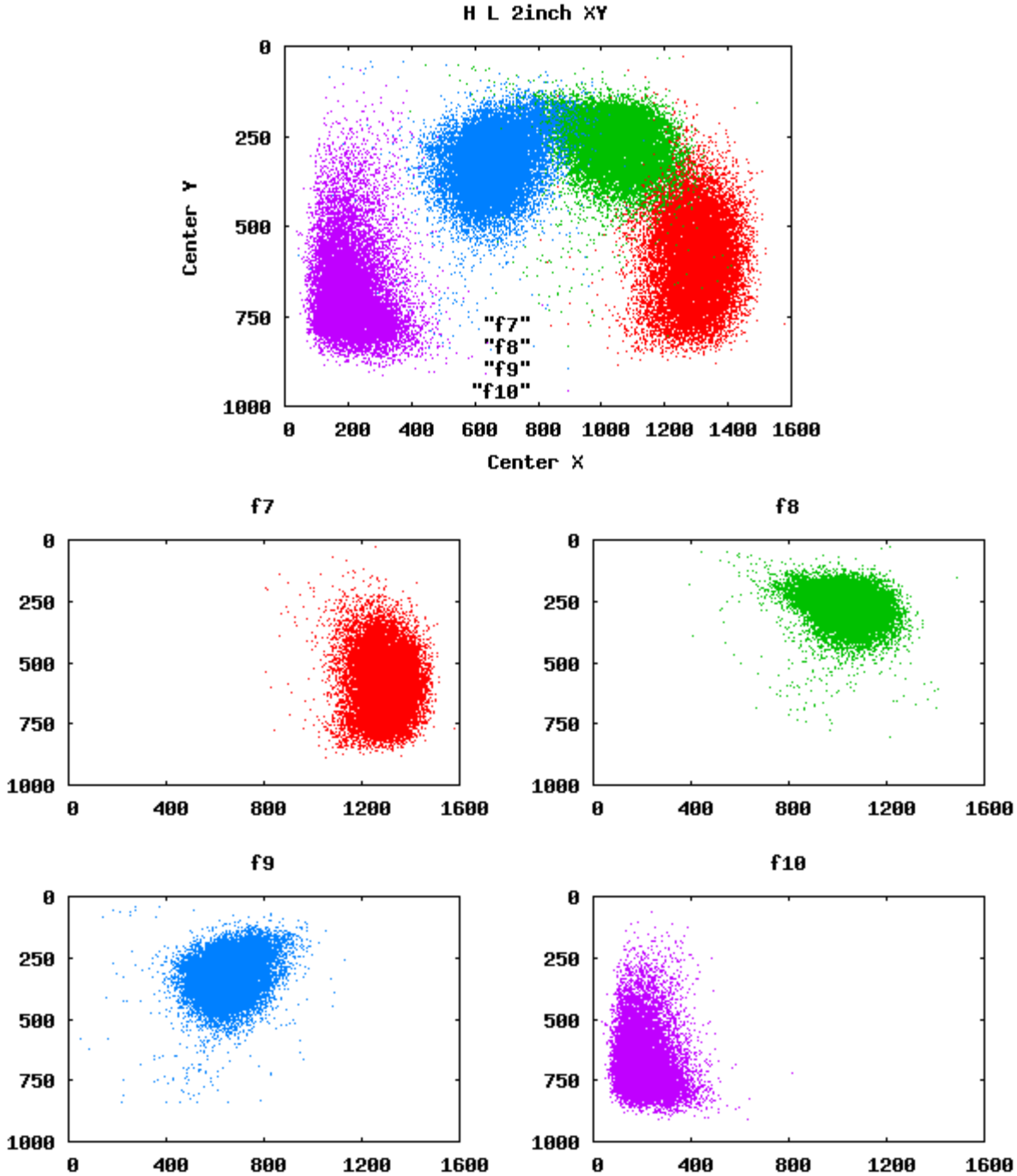

H L 3inch WH
Height
Width
"f7"
"f8"
"f9"
"f10"


H T 3inch WH
Height
Width
"f1"
"f6"

## Appendix F. Plots of 2-inch segmentation box centers.

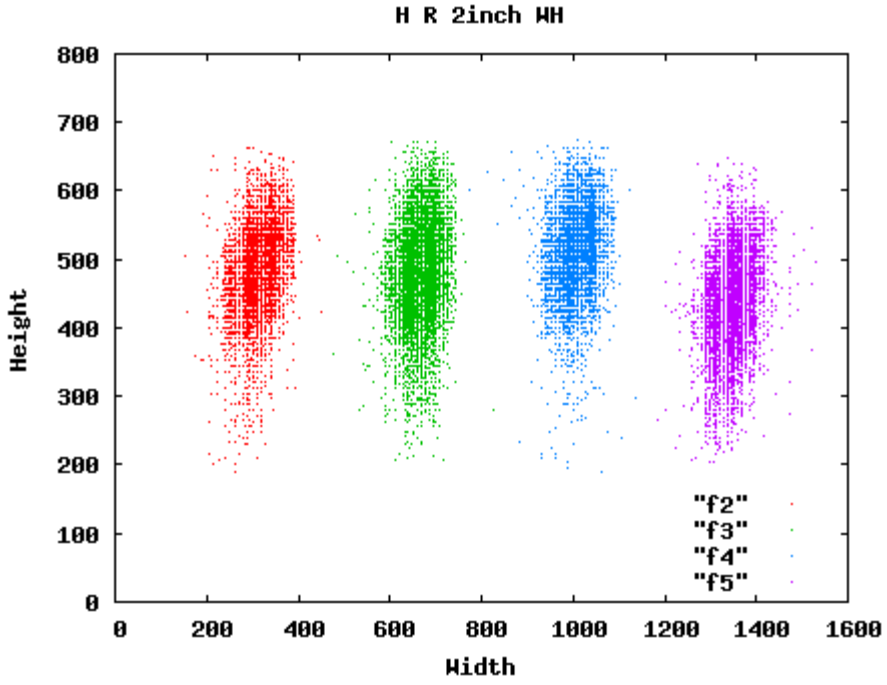
The plots in this appendix show the distribution of the segmentation box centers (x,y) for the 2-inch data. There is a combined plot for each slap image and then a smaller plot for each finger position. The individual finger plots are better for seeing the full “spread” of x,y positions detected. The plot for the ground truth (GT) is included as a baseline for comparison. The blank lines that appear in some of the plots are most likely caused by the segmentation algorithm doing some level of sampling of the input image. The reason the lines are not evenly distributed in some plots is an artifact of the sampling when scaling the images for displaying in the report.

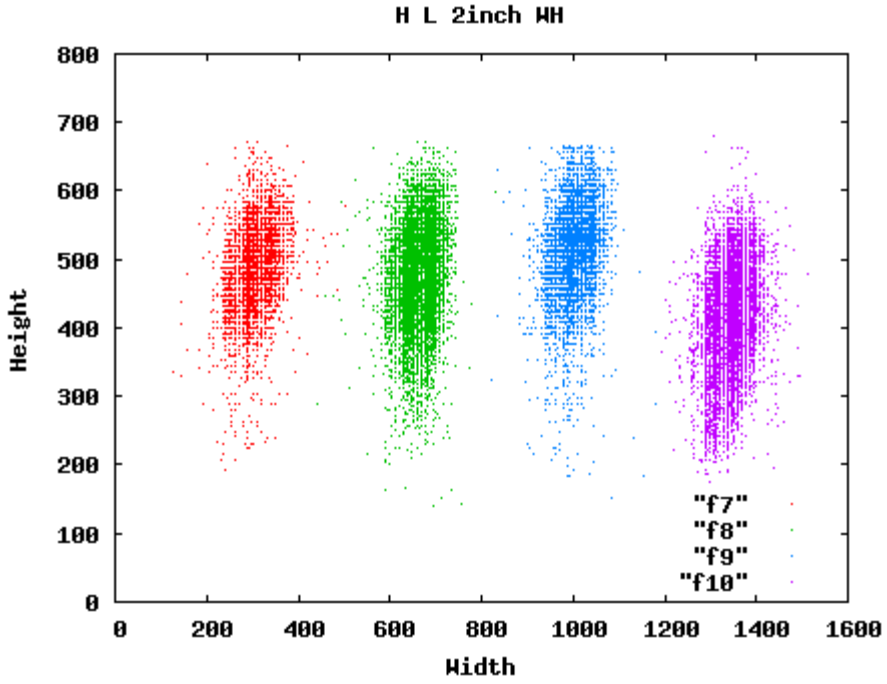

H R 2inch XY
Center Y
Center X
"f2"
"f3"
"f4"
"f5"
f2
f3
f4
f5


H L 2inch XY
Center Y
Center X
"f7"
"f8"
"f9"
"f10"
f7
f8
f9
f10

## Appendix G. Plots of 2-inch segmentation box widths and heights.

The plots in this appendix show the distribution of the segmentation box widths and heights for the 2-inch data. There is a combined plot for each slap image and then a smaller plot for each finger position. The individual finger plots are better for seeing the full “spread” of widths and heights detected. The widths are “spread out” on the plot by adding 350, 750 and 1050 to the 2$^{nd}$, 3$^{rd}$, and 4$^{th}$ widths plotted. The plot for the ground truth (GT) is included as a baseline for comparison. The blank lines that appear in some of the plots are most likely caused by the segmentation algorithm doing some level of sampling of the input image. The reason the lines are not evenly distributed in some plots is an artifact of the sampling when scaling the images for displaying in the report.


H R 2inch WH
Height
Width
"f2"
"f3"
"f4"
"f5"


H L 2inch WH
Height
Width
"f7"
"f8"
"f9"
"f10"