TigerImp+0002

Tiger IT Bangladesh Limited

Slap Fingerprint Segmentation Evaluation III

Last Updated: 22 January 2025

Contents

1 Participation Information

1.1 Names and Dates

- **Organization Name:** Tiger IT Bangladesh Limited
- **SlapSeg III Identifier:** TigerImp+0002
- **SlapSeg III API Version:** 1.2.0
- **Provided Marketing Name:** "TigerIT SlapSegIII Implementation"
- **Application Date:** 14 January 2025
- **First Submission Date:** 14 January 2025 (as version 0001)
- **Validation Date:** 15 January 2025
- **Completion Date:** 22 January 2025

1.2 Libraries

Filename	MD5 Checksum	Size
libtigerFP.so	ad2413b4411a4082189f260ee6a9cd08	95 kB
libslapsegiii_TigerImp_0002.so	69ed911e5d8eedc5513b21b2302aa875	227 kB
libopencv_core.so.3.4	9b0b9fa2466a3c204689b5edaff1bb22	15 MB
libopencv_imgproc.so.3.4	501cb5e014854f88616154af3f2b0430	42 MB
libonnxruntime.so.1.12.0	626eba1159cc701d30c20f86a37c3d20	17 MB
tigerFP.conf	4efe364146de840a3fce6cd3a58a5a7d	15 MB

2 Tenprint Cards ("TwoInch" Data)

2.1 Segmentation Timing

All algorithms are run over a small fixed corpus of TwoInch images to estimate the total runtime of the evaluation. To be evaluated under SlapSeg III, algorithms **must** segment the timing corpus, on average, in under 1 500 milliseconds. This maximum reference time is documented in the SlapSeg III test plan, and is subject to change. Times are measured by running a single process on an isolated compute node equipped with an Intel Gold 6254 CPU (submissions received prior to February 2022 were timed with a Intel Xeon E5-4650 CPU).*=

Box plots of segmentation times are separated by slap orientation and capture technology in Figure 1. Tabular representations are enumerated in Table 1. Results are reported in milliseconds.

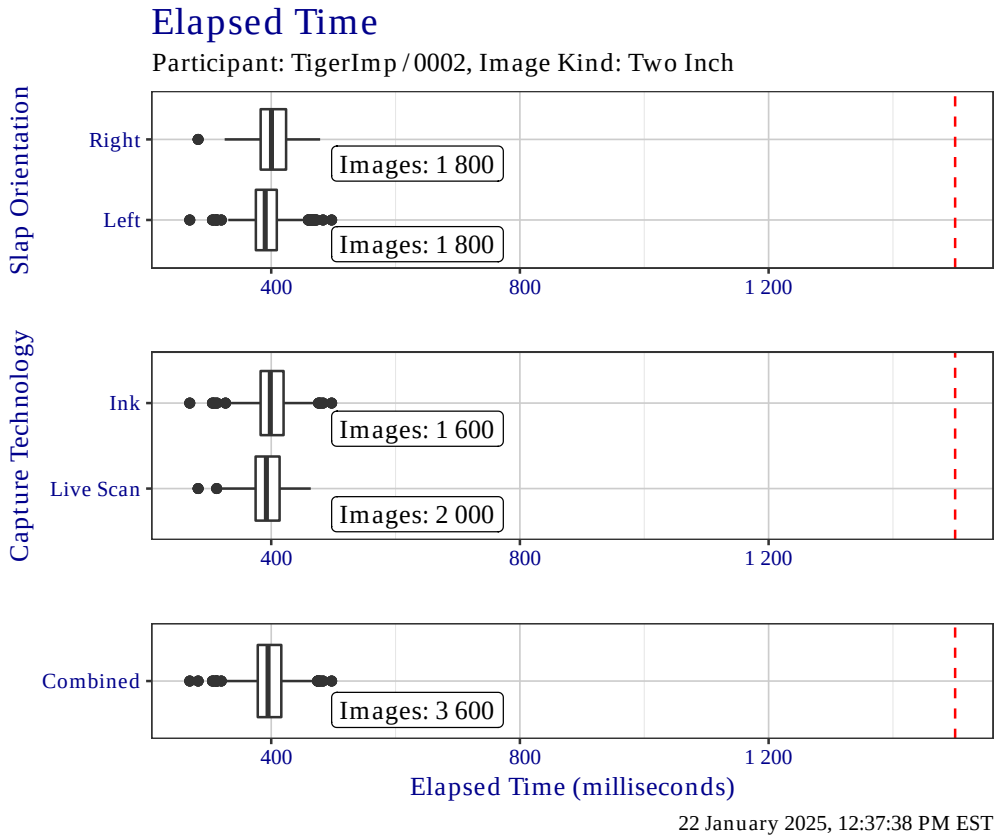

Figure 1: Box plots of elapsed time in milliseconds when segmenting the TwoInch timing test corpus, separated by slap orientation and capture technology.

Table 1: Elapsed time in milliseconds when segmenting the TwoInch timing test corpus, separated by slap orientation and capture technology.

	Right	Left	Live Scan	Ink	Combined
Minimum	282	269	282	269	269
25%	383	375	375	383	378
Median	400	390	392	399	395
75%	424	409	413	420	416
Maximum	479	497	464	497	497

2.2 Segmentation Centers and Dimensions

2.2.1 Segmentation Centers

The plots in this section show the distribution of segmentation position centers (x, y) for TwoInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation centers for the right hand TwoInch data are shown in Figure 2 and plots of segmentation centers for the left hand are shown in Figure 3. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Centers have been normalized to 500 pixels per inch.

Points in each plot are plotted with a semi-transparent opacity. This results in points of particular color appearing "darker" to indicate a higher frequency of the observed value, while "lighter" points indicate a lower observed frequency.

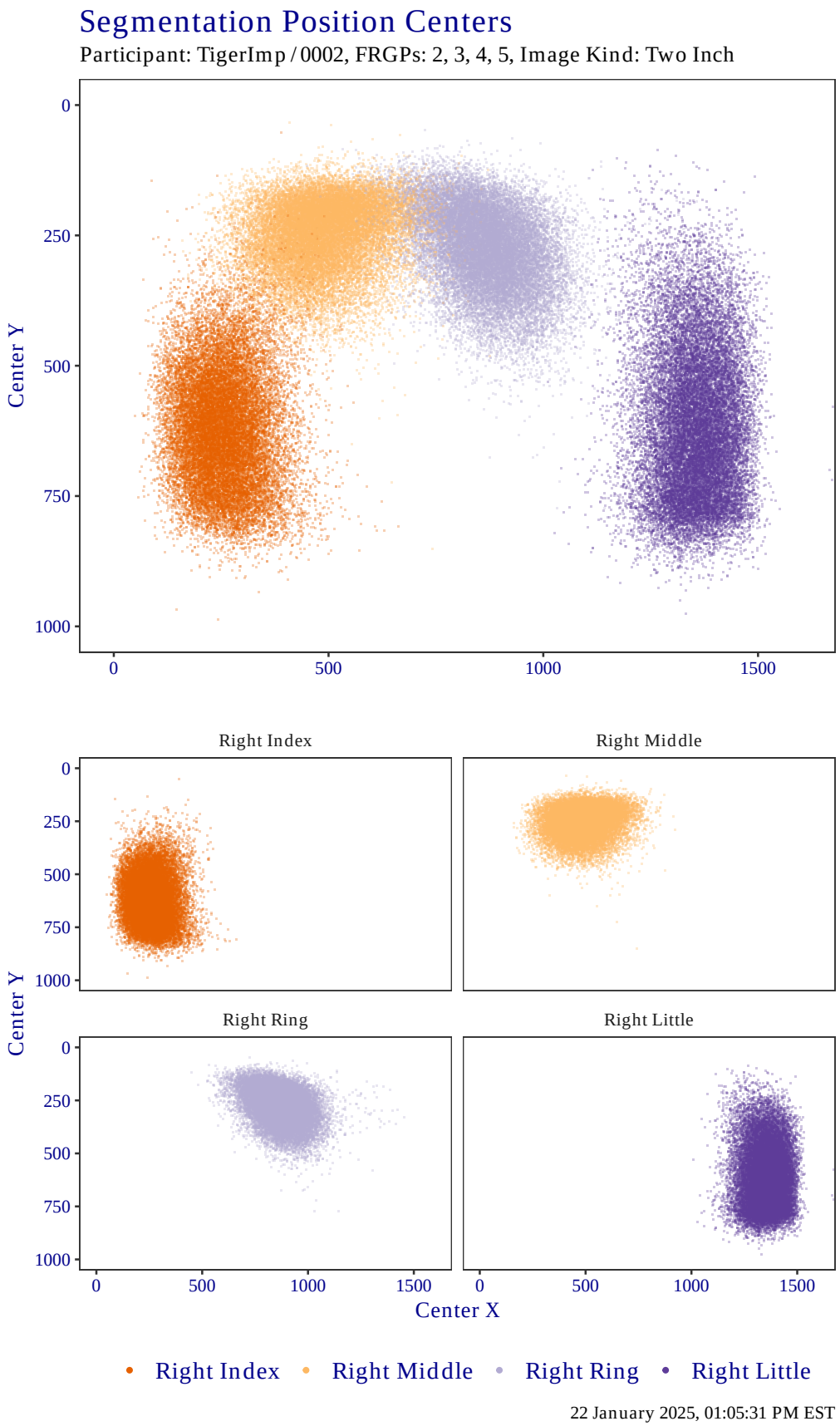

Figure 2: Segmentation centers for right hand TwoInch data.

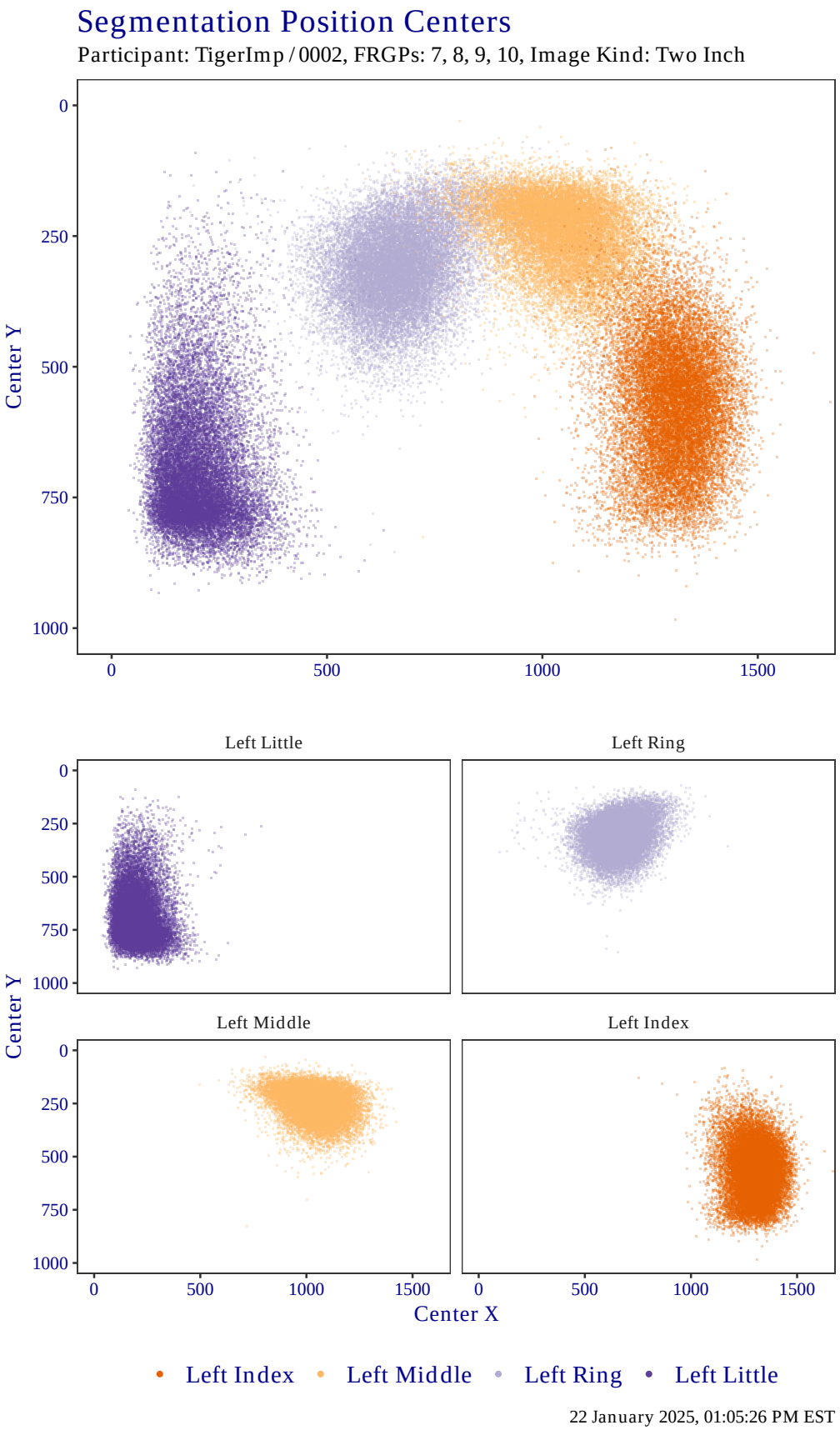

Figure 3: Segmentation centers for left hand TwoInch data.

2.2.2 Segmentation Dimensions

The plots in this section show the distribution of segmentation position widths and heights for TwoInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation position dimensions for the right hand TwoInch data are shown in Figure 4 and the left hand in Figure 5. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Dimensions have been normalized to 500 pixels per inch.

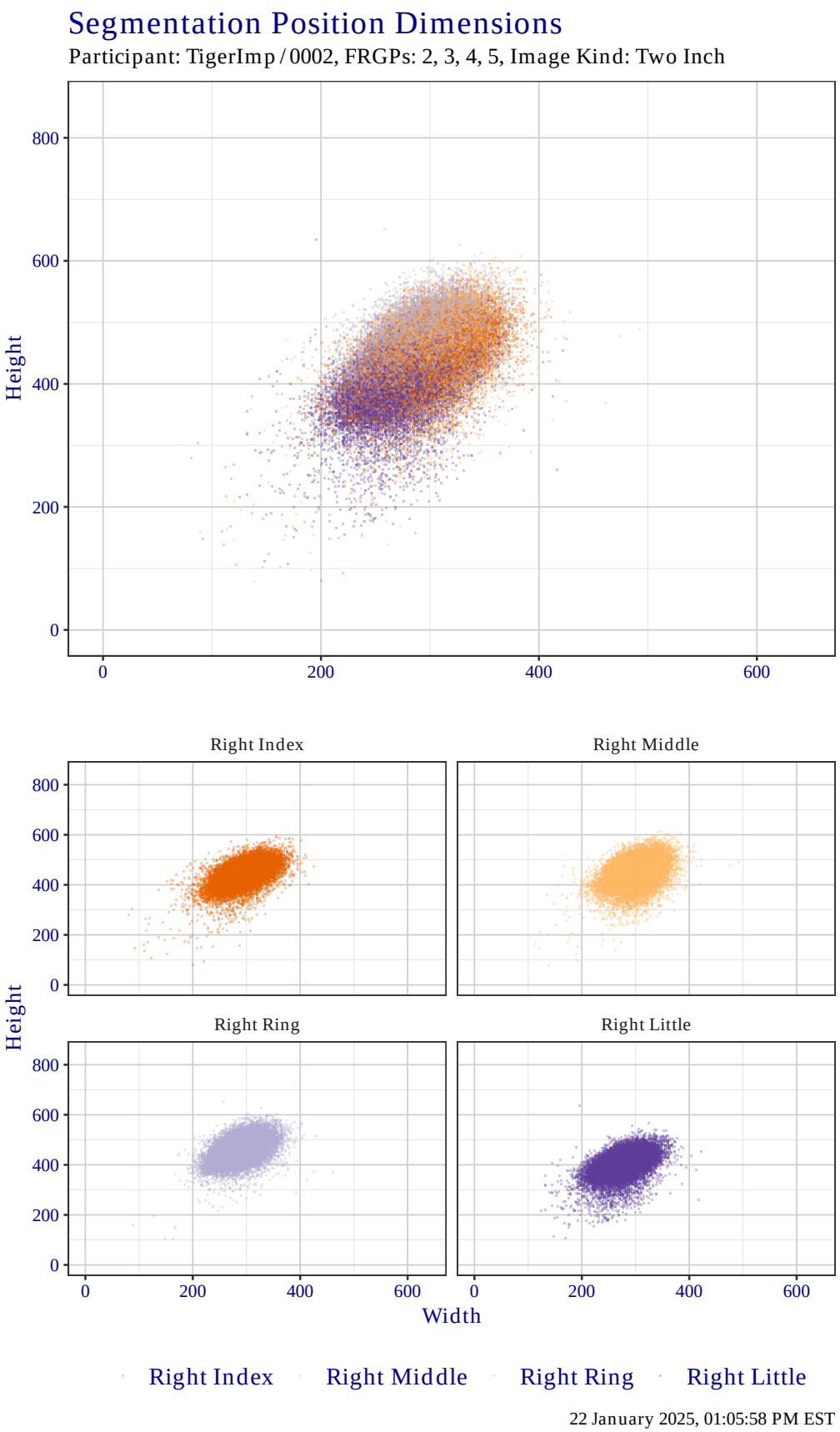

Figure 4: Segmentation position dimensions for right hand TwoInch data.

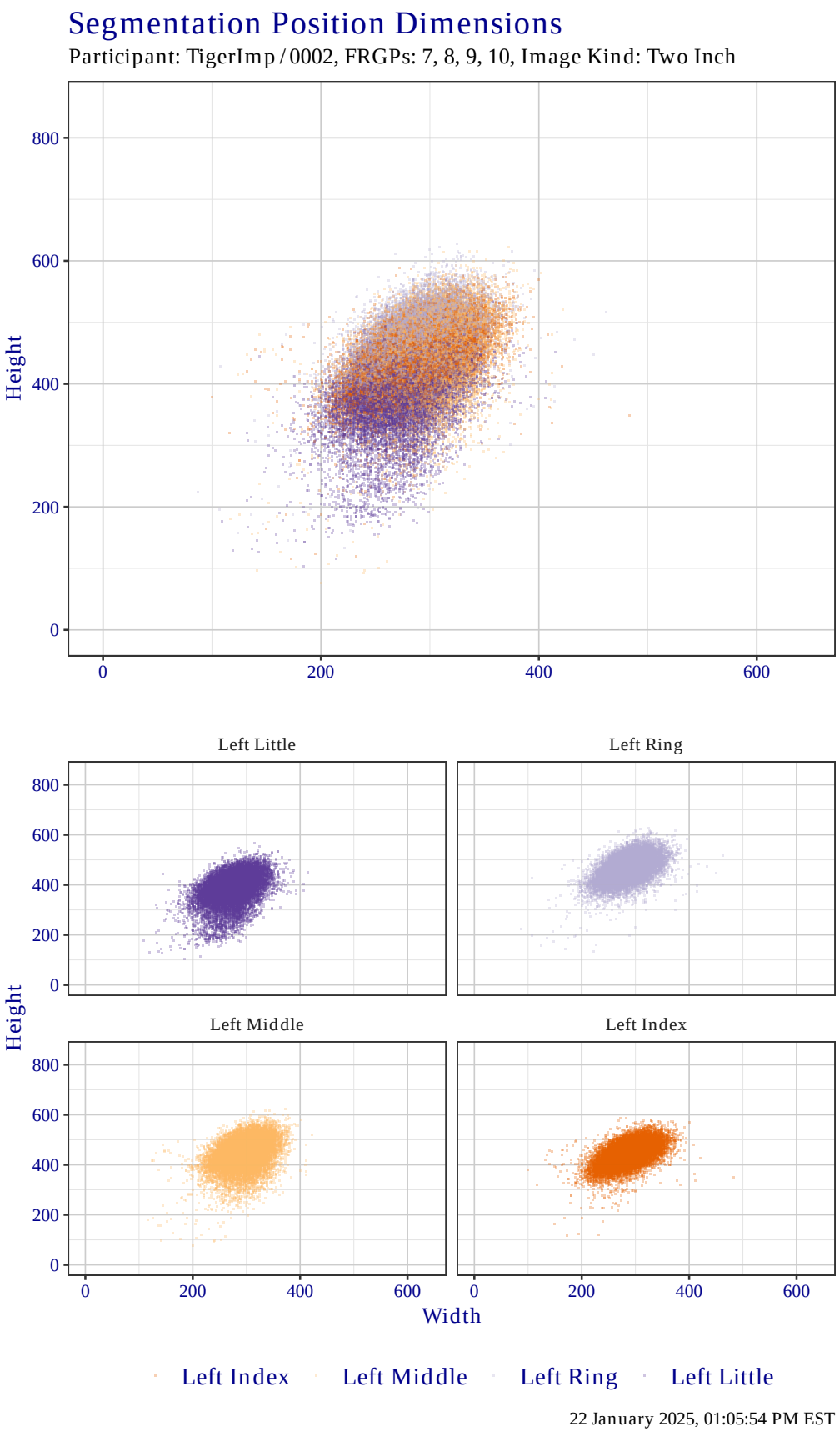

Figure 5: Segmentation position dimensions for left hand TwoInch data.

2.3 Detailed Segmentation Statistics

This section shows detailed results of segmentation of TwoInch data. Values in each table are the percentage that the variable in the left-most column was correctly segmented.

Each table has three columns of percentages. The *Standard Scoring* column shows the percentage of correctly-segmented positions based on the scoring metrics defined in the SlapSeg III scoring document. The *Ignoring Bottom Y* column shows how the percentage would change if the threshold for the *bottom Y* coordinate of the segmentation position was ignored. Similarly, the *Ignoring Bottom X and Y* columns shows how the percentage would change if only the top, left, and right sides of the segmentation position were considered. These two supplemental columns are included because it has traditionally been difficult to determine the exact location of the distal interphalangeal joint.

Table 2 shows how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 3 shows success for specific finger positions over the entire test corpus. Similarly, Table 4 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers on each slap image. Table 5 shows success for combinations of all fingers, Table 6 for just the index and middle fingers, and Table 7 for all except the little finger.

Table 2: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.9	99.9	99.9
2	99.8	99.8	99.8
3	99.5	99.5	99.6
4	98.8	98.9	99.0
5	95.0	95.1	95.2
6	94.4	94.6	94.9
7	92.8	93.4	93.8
8	83.6	86.6	87.3

Table 3: For all subjects, percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	95.8	96.9	97.1
Middle	97.5	98.0	98.2
Ring	97.8	98.2	98.4
Little	97.9	98.5	98.8
Left			
Index	97.1	97.6	97.7
Middle	97.4	97.9	98.1
Ring	97.8	98.4	98.5
Little	98.1	98.4	98.6

Table 4: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	99.3	99.4	99.4
Both	89.9	91.1	91.5
Middle			
Either	99.4	99.5	99.5
Both	91.7	92.5	92.8
Ring			
Either	99.5	99.6	99.6
Both	92.3	93.2	93.5
Little			
Either	99.4	99.4	99.5
Both	92.4	93.1	93.6

Table 5: Percentage of segmentation success by hand for combinations of all eight fingers of a TwoInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.5	99.5	99.6
At Least Two	99.3	99.3	99.5
At Least Three	98.5	98.7	99.0
All Four	91.6	94.0	94.4
Left			
Any	99.5	99.5	99.6
At Least Two	99.2	99.3	99.4
At Least Three	98.5	98.7	98.8
All Four	93.2	94.8	95.1

Table 6: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	99.1	99.2	99.3
Both Index and Middle	94.2	95.7	96.0
Left			
Either Index or Middle	99.0	99.1	99.2
Both Index and Middle	95.5	96.4	96.6

Table 7: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.4	99.5	99.6
At Least Two	98.8	98.9	99.2
All Three	92.9	94.7	95.0
Left			
Any	99.4	99.4	99.5
At Least Two	98.7	98.8	99.0
All Three	94.3	95.6	95.8

2.4 Handling Troublesome Images

2.4.1 Capture Failures

Segmentation algorithms may refuse to process an image. This may happen for a technical reason (e.g., the algorithm cannot parse the image data), or for a practical reason (e.g., the hand in the image is placed incorrectly). These failure scenarios are the result of capturing improper image data. In these types of scenarios, it is important to examine the cause of the failure. With many live scan capture setups, segmentation is performed immediately after capture. If an algorithm can detect that it won't be able to segment an image due to a technical or practical issue, it can alert the operator to perform a recapture before the subject leaves.

The SlapSeg III API encourages algorithms to identify these failure reasons by specifying pre-defined *deficiencies* in the image. Algorithms should attempt segmentation even if an image deficiency is encountered if at all possible. Note that SlapSeg III *guarantees* well-formed image data, so failures to parse are **not** an indicator of the data provided.

`TigerImp+0002` did **not** report any capture failures.

2.4.1.1 Recovery

When encountering a segmentation failure, SlapSeg III algorithms are encouraged to provide a *best-effort* segmentation when possible. In some cases, that best-effort may be correct, which reduces the amount of images that need to be manually adjudicated by an operator.

`TigerImp+0002` did not attempt any recovery segmentations.

2.4.2 Segmentation Failures

Even if an algorithm accepts an image for processing, it can still fail to process one or more fingers from the image, regardless of if the algorithm requested a recapture and provided best-effort segmentation.

The SlapSeg III API allows algorithms to communicate reasons for failure to process these fingers. In some cases, the distal phalanx in question might not be present in the image due to amputation or being placed outside the platen's capture area. It is imperative that the segmentation algorithm correctly report this as failing to segment the correct friction ridge generalized position without disrupting the sequence of valid positions present in the image. This can help prompt an operator to recapture or record additional information about the subject.

In SlapSeg III, a number of images are missing fingers or otherwise have fingers that will not be able to be segmented. Reasons for segmentation failures reported by `TigerImp+0002` are enumerated in Table 8.

Table 8: Count of self-reported segmentation failure reasoning.

Failure Reason	Fingers
Finger Not Found	562
Finger Found, but Can't Segment	0
Vendor Defined	0

2.4.3 Identifying Missing Fingers

A small portion of the test corpus in SlapSeg III are missing fingers. Table 9 shows how successful `TigerImp+0002` was in correctly determining if a finger was missing. The *Missed* row shows when a segmentation position was returned for a missing finger. All possible failure reasons are enumerated, but are not considered *Correctly Identified* because the algorithm specified failure for a reason other than the finger not being found.

Table 9: Performance of TigerImp+0002 at detecting fingers missing from an image.

Result	Percentage
Missed	15.6
Correctly Identified	84.4
Other Failure: Finger Found, but Can't Segment	0.0
Other Failure: Vendor Defined	0.0
Other Failure: Segmentation Not Attempted	0.0

2.4.4 Sequence Error

Sequence error occurs when a fingerprint is segmented from an image but assigned an incorrect finger position (e.g., segmenting a right middle finger but labeling it a right index finger). Table 10 shows cases in which a segmentation position was returned that matched a ground truth segmentation position for a different finger in the same image.

Table 10: Percentage of images in the dataset where one or more segmentation positions correctly matched an incorrect finger position within the same image, indicating sequence error.

Hand	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Left	0.22	0.22	0.22
Right	0.14	0.14	0.14
Combined	0.17	0.17	0.18

3 Identification Flats ("ThreeInch" Data)

3.1 Segmentation Timing

All algorithms are run over a small fixed corpus of ThreeInch images to estimate the total runtime of the evaluation. To be evaluated under SlapSeg III, algorithms **must** segment the timing corpus, on average, in under 1 500 milliseconds. This maximum reference time is documented in the SlapSeg III test plan, and is subject to change. Times are measured by running a single process on an isolated compute node equipped with an Intel Gold 6254 CPU (submissions received prior to February 2022 were timed with a Intel Xeon E5-4650 CPU).

Box plots of segmentation times are separated by hand in Figure 6, with tabular representations are enumerated in Table 11. Results are reported in milliseconds

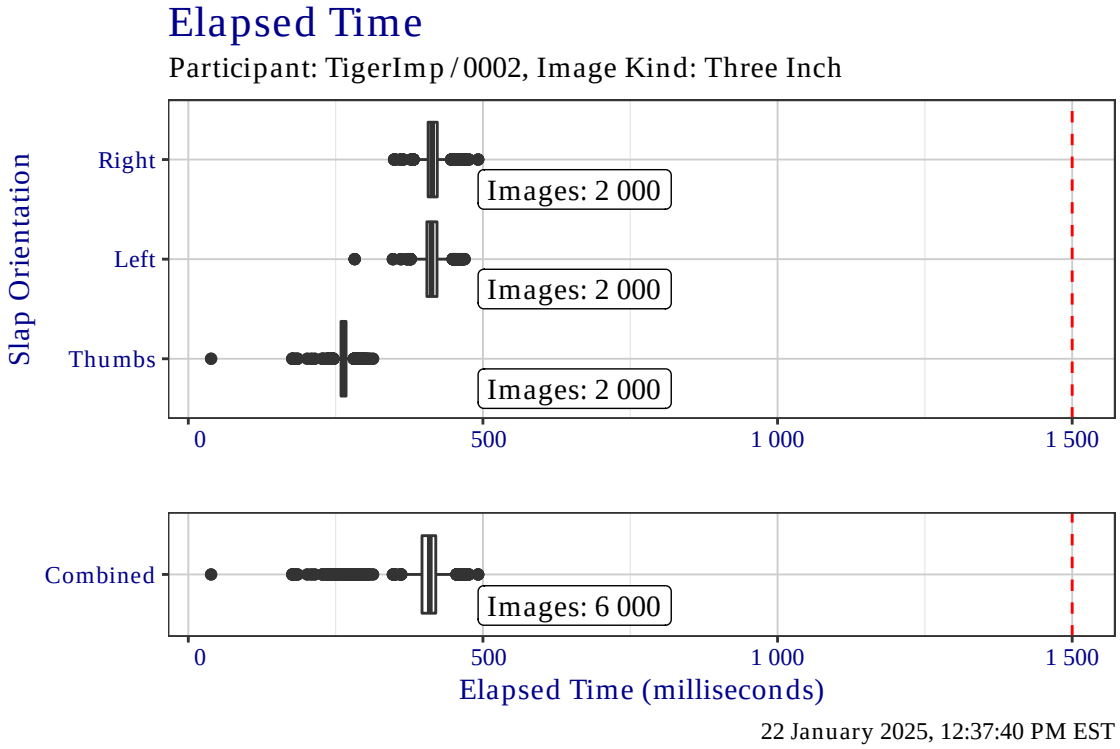

Figure 6: Box plots of elapsed time in milliseconds when segmenting the ThreeInch timing test corpus, separated by slap orientation.

Table 11: Elapsed time in milliseconds when segmenting the ThreeInch timing test corpus, separated by slap orientation.

	Right	Left	Thumbs	Combined
Minimum	349	282	39	39
25%	407	405	259	397
Median	414	413	264	410
75%	423	422	268	420
Maximum	492	469	313	492

3.2 Segmentation Centers and Dimensions

3.2.1 Segmentation Centers

The plots in this section show the distribution of segmentation position centers (x, y) for ThreeInch data. At the top of each figure is a combined plot for all finger positions of a given hand orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation centers for the right hand ThreeInch data are shown in Figure 7, for the left hand in Figure 8, and for thumbs in Figure 9. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Centers have been normalized to 500 pixels per inch.

Points in each plot are plotted with a semi-transparent opacity. This results in points of particular color appearing "darker" to indicate a higher frequency of the observed value, while "lighter" points indicate a lower observed frequency.

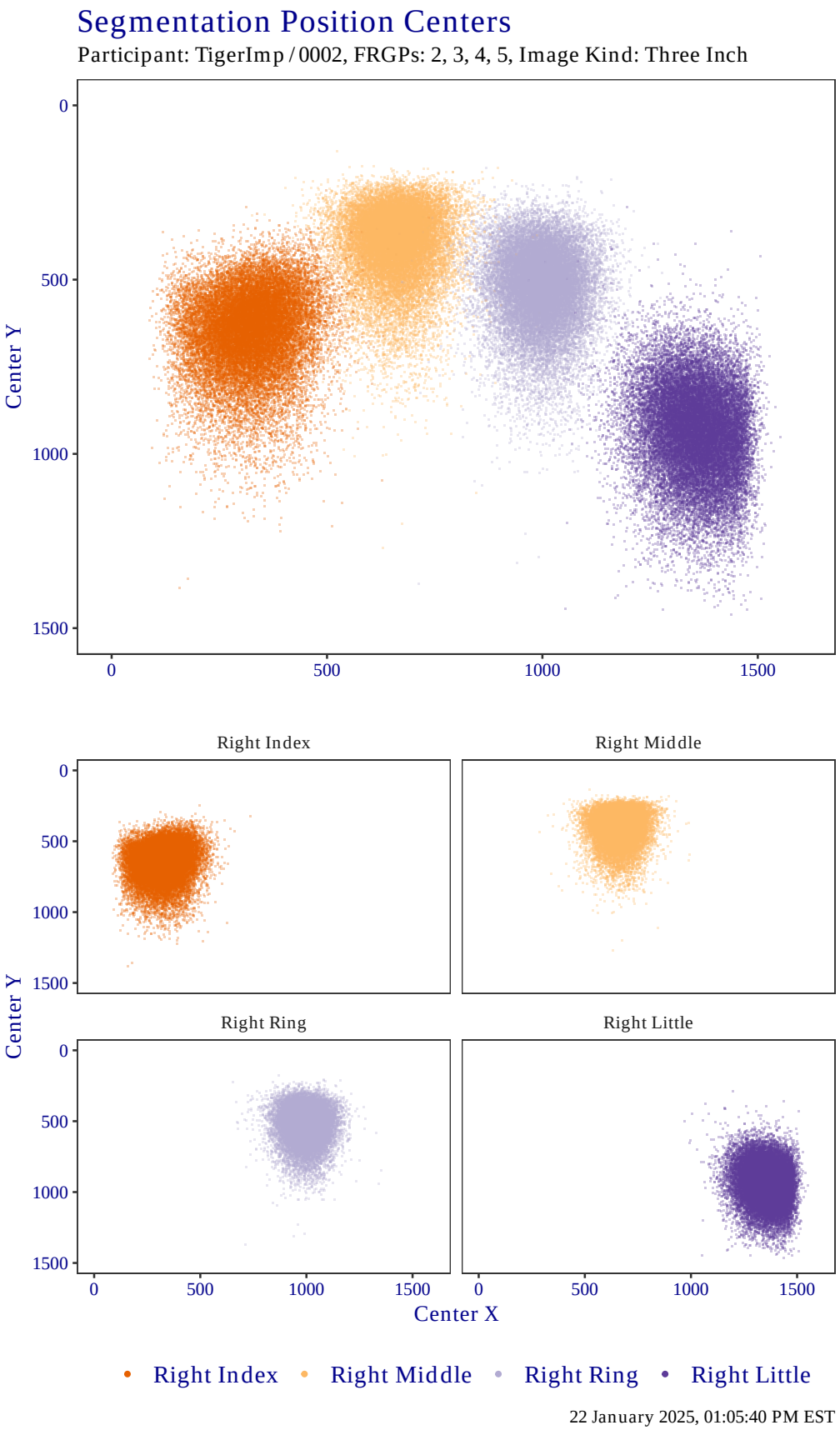

Figure 7: Segmentation centers for right hand ThreeInch data.

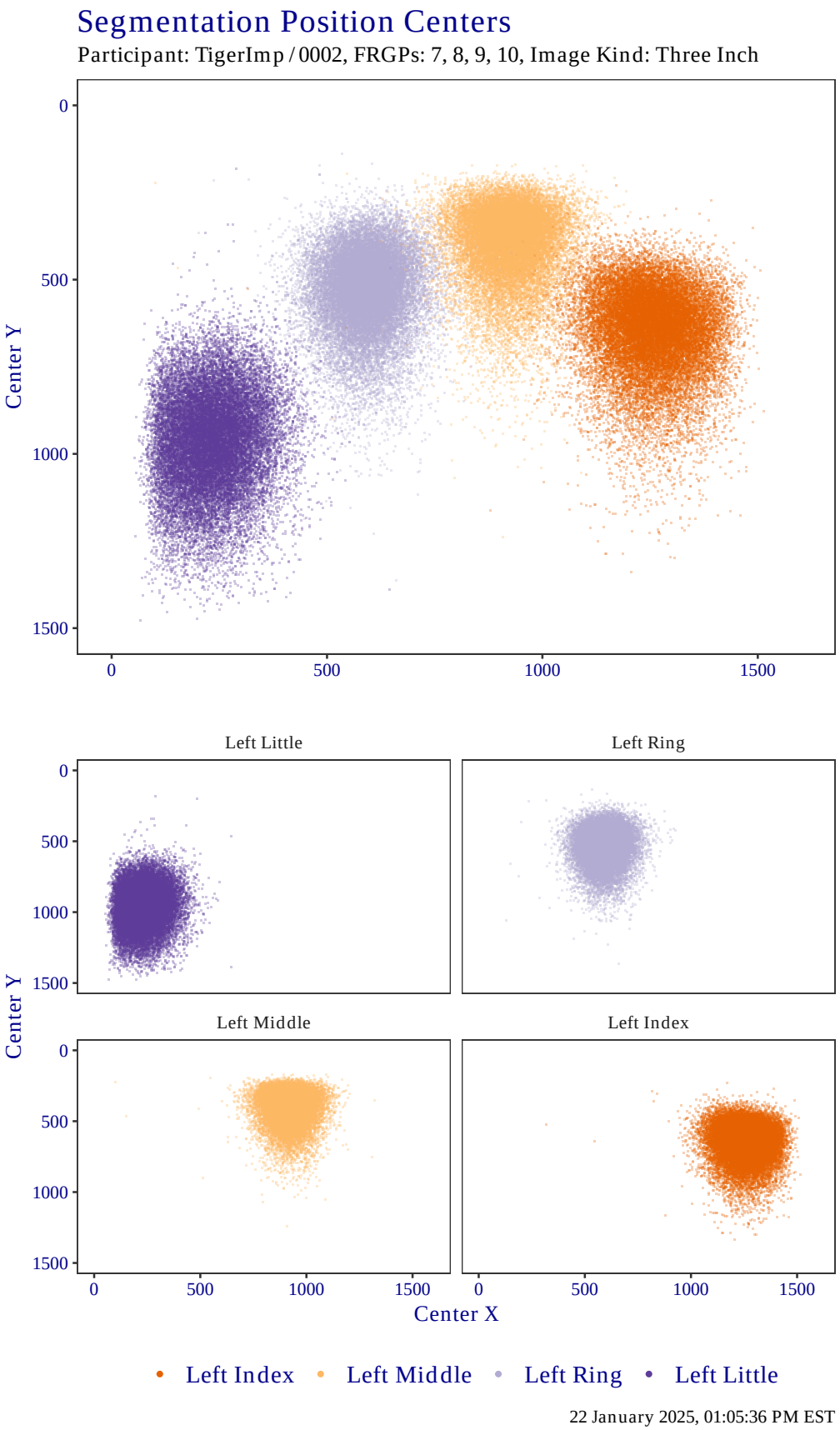

Figure 8: Segmentation centers for left hand ThreeInch data.

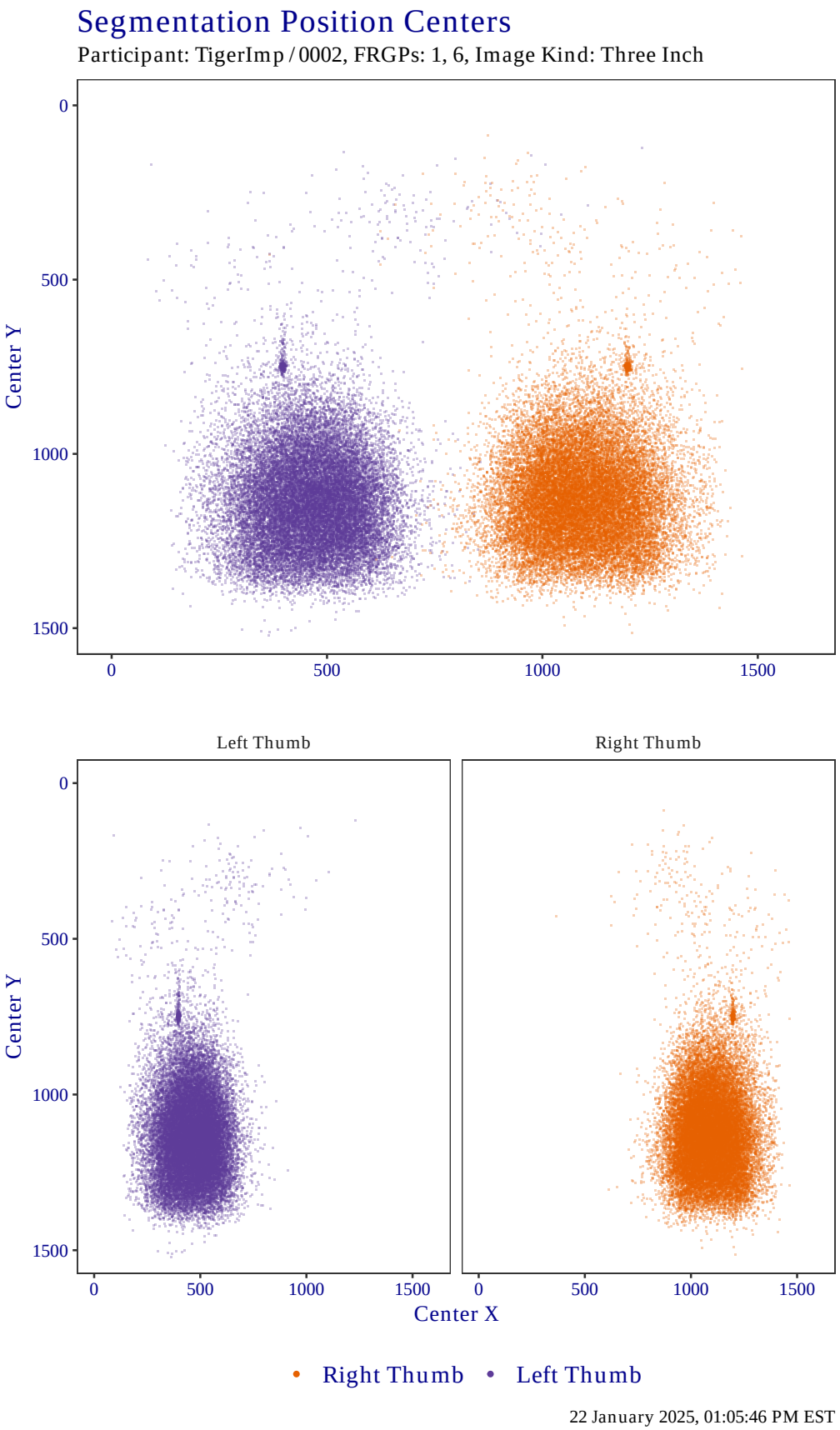

Figure 9: Segmentation centers for thumb ThreeInch data.

3.2.2 Segmentation Dimensions

The plots in this section show the distribution of segmentation position widths and heights for ThreeInch data. At the top of each figure is a combined plot for all finger positions of a given hand orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation position dimensions for the right hand ThreeInch data are shown in Figure 11, for the left hand in Figure 10, and for thumbs in Figure 12. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Dimensions have been normalized to 500 pixels per inch.

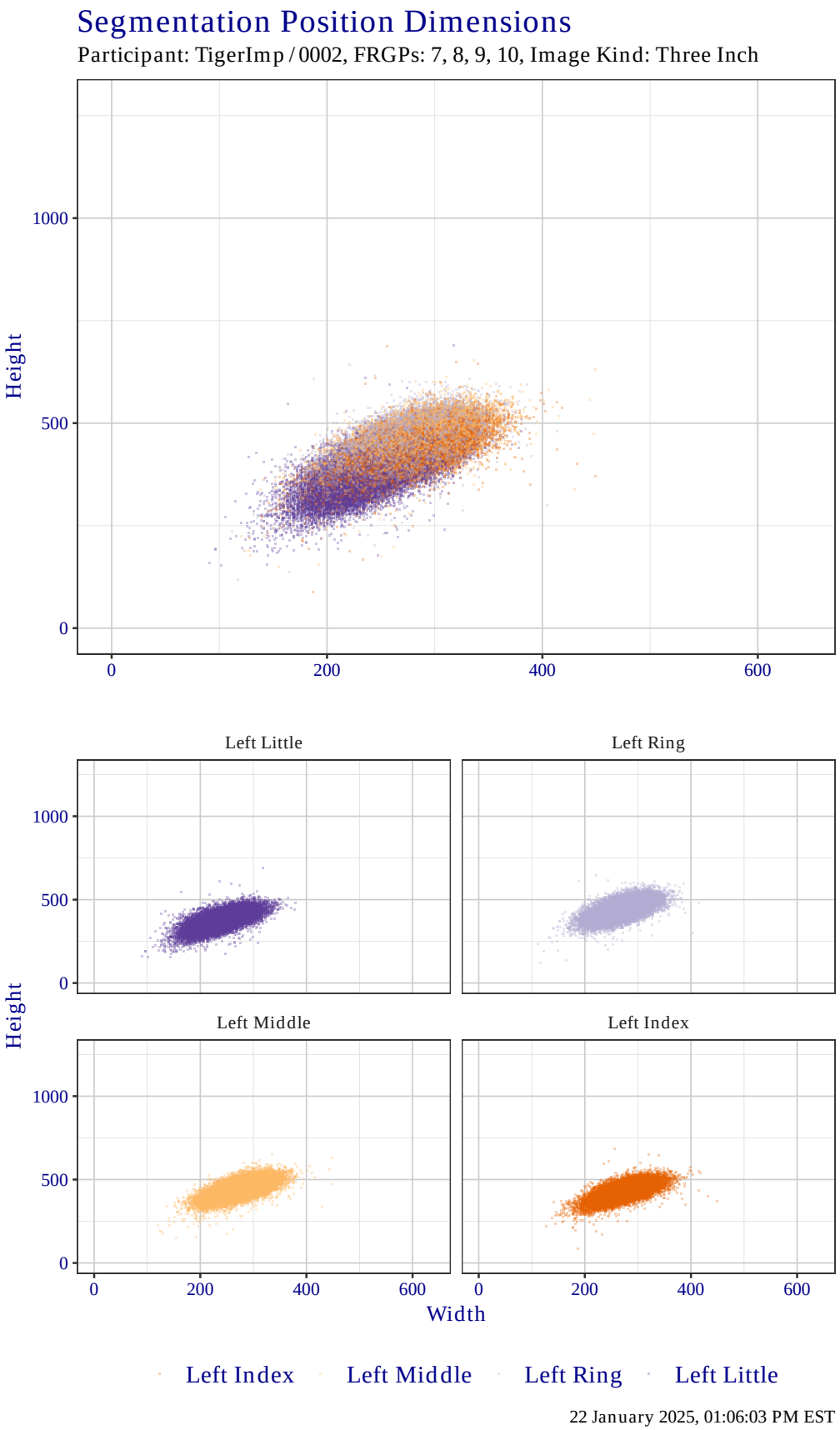

Figure 10: Segmentation position dimensions for left hand ThreeInch data.

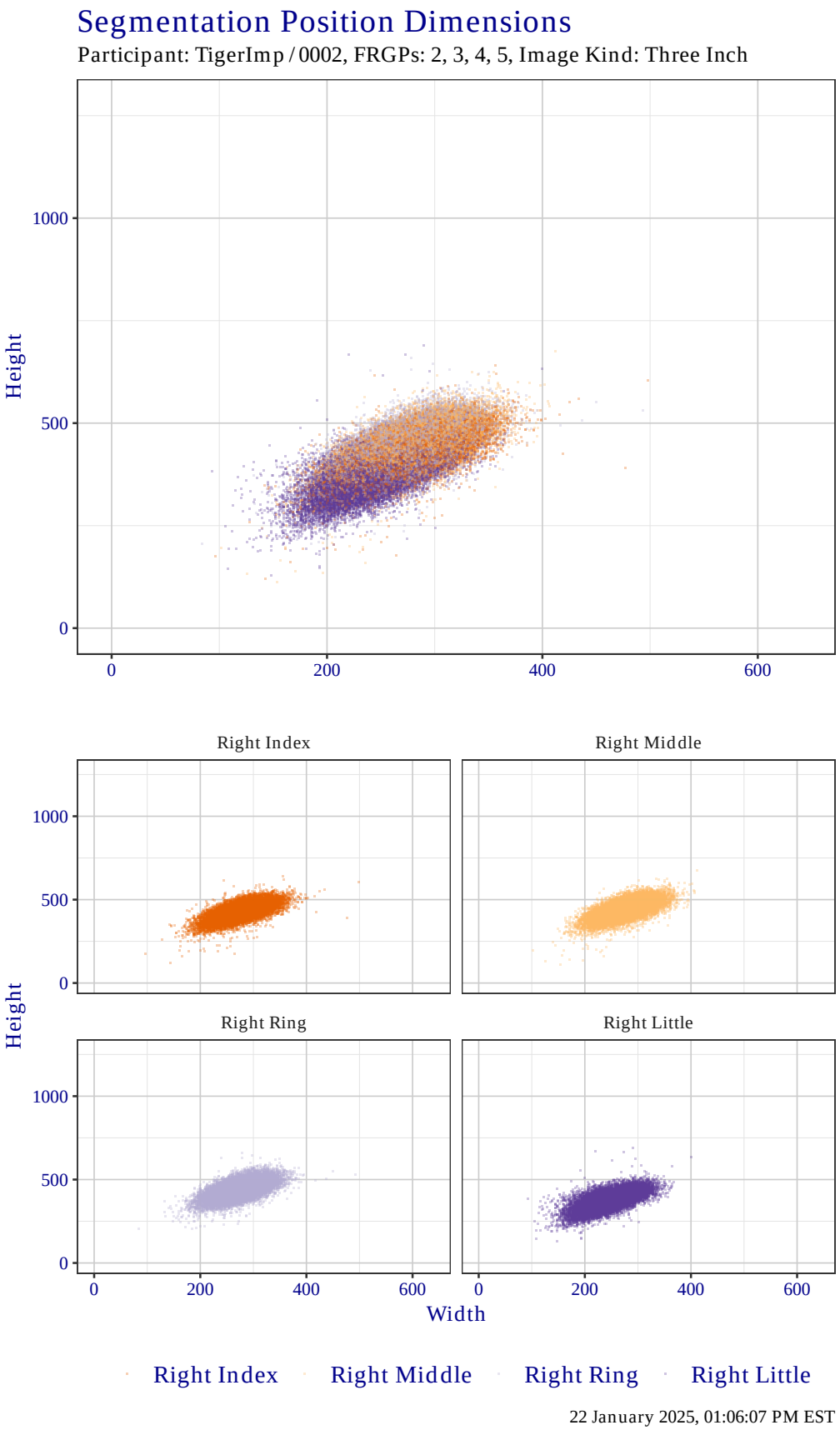

Figure 11: Segmentation position dimensions for right hand ThreeInch data.

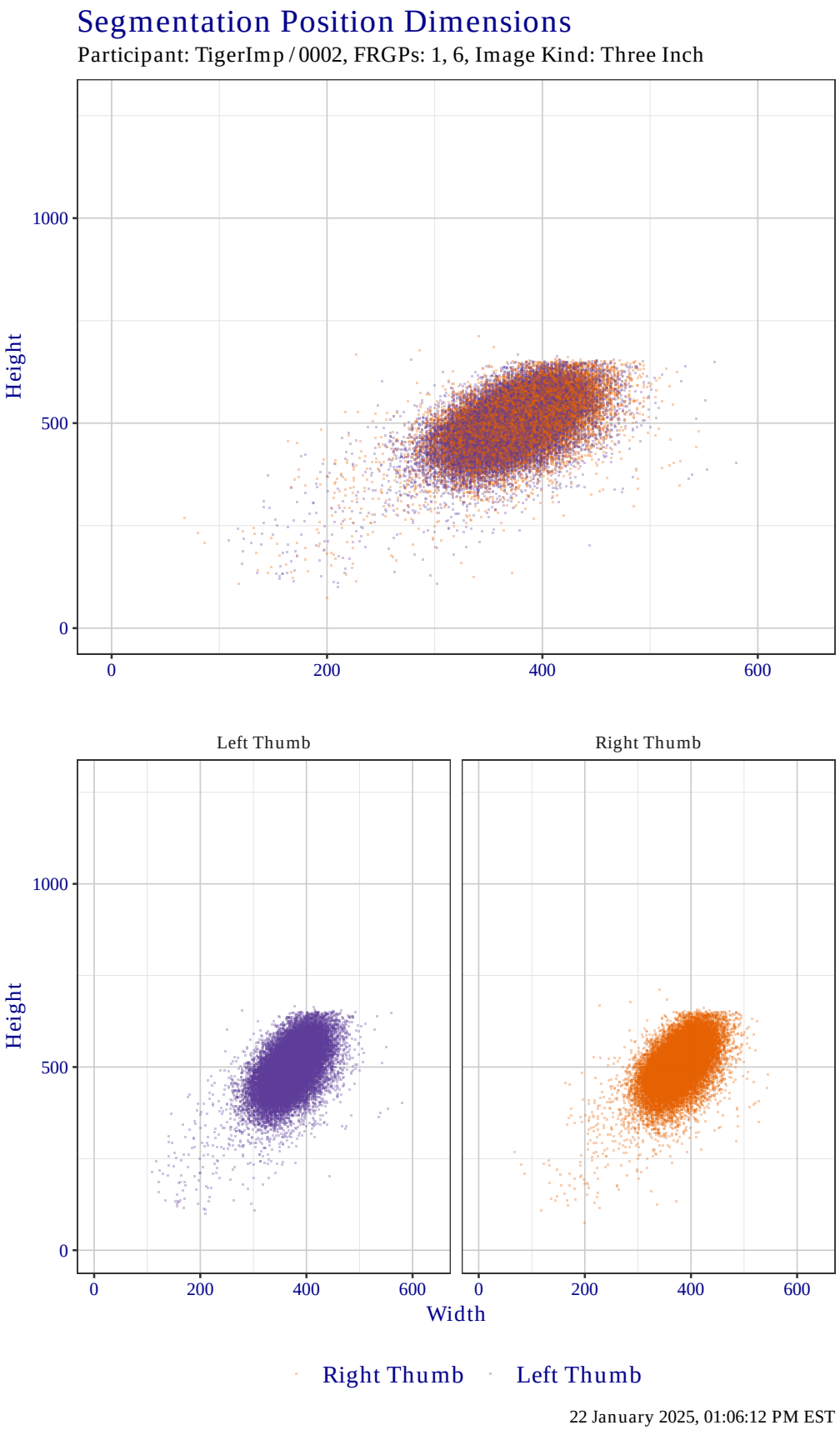

Figure 12: Segmentation position dimensions for thumb ThreeInch data.

3.3 Detailed Segmentation Statistics

This section shows detailed results of segmentation of ThreeInch data. Values in each table are the percentage that the variable in the left-most column was correctly segmented.

Each table has three columns of percentages. The *Standard Scoring* column shows the percentage of correctly-segmented positions based on the scoring metrics defined in the SlapSeg III scoring document. The *Ignoring Bottom Y* column shows how the percentage would change if the threshold for the *bottom Y* coordinate of the segmentation position was ignored. Similarly, the *Ignoring Bottom X and Y* columns shows how the percentage would change if only the top, left, and right sides of the segmentation position were considered. These two supplemental columns are included because it has traditionally been difficult to determine the exact location of the distal interphalangeal joint.

Table 12 shows how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 13 shows success for specific finger positions over the entire test corpus. Similarly, Table 14 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers on each slap image. Table 15 shows success for combinations of all fingers, Table 16 for just the index and middle fingers, and Table 17 for all except the little finger.

Table 12: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.8	99.8	99.8
2	99.2	99.2	99.2
3	98.4	98.4	98.5
4	98.1	98.1	98.1
5	95.9	95.9	95.9
6	95.8	95.8	95.9
7	95.8	95.8	95.8
8	95.4	95.4	95.5
9	92.9	93.0	93.7
10	81.9	82.3	84.9

Table 13: For all subjects, percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Thumb	95.3	95.3	96.2
Index	99.2	99.2	99.3
Middle	98.9	98.9	99.3
Ring	97.9	98.0	98.4
Little	98.0	98.1	98.2
Left			
Thumb	95.9	96.0	96.9
Index	98.3	98.3	98.4
Middle	98.7	98.7	99.1
Ring	98.8	99.0	99.3
Little	98.4	98.4	98.5

Table 14: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Thumb			
Either	98.7	98.7	99.0
Both	92.5	92.7	94.2
Index			
Either	99.8	99.8	99.8
Both	95.1	95.1	95.3
Middle			
Either	99.7	99.7	99.8
Both	95.2	95.2	95.9
Ring			
Either	99.7	99.7	99.8
Both	94.3	94.5	95.2
Little			
Either	99.6	99.6	99.6
Both	94.2	94.2	94.4

Table 15: Percentage of segmentation success by hand for combinations of all ten fingers of a ThreeInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.4	99.4	99.4
At Least Two	98.4	98.4	98.5
At Least Three	98.3	98.3	98.4
At Least Four	97.3	97.3	97.5
All Five	86.9	87.1	88.7
Left			
Any	99.6	99.6	99.6
At Least Two	98.5	98.5	98.5
At Least Three	98.3	98.3	98.3
At Least Four	97.3	97.3	97.5
All Five	87.4	87.7	89.2

Table 16: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are gnored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either	99.8	99.8	99.9
Both	98.3	98.3	98.8
Left			
Either	99.8	99.8	99.8
Both	97.2	97.2	97.7

Table 17: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.9	99.9	99.9
At Least Two	99.6	99.6	99.7
All Three	96.5	96.6	97.4
Left			
Any	99.9	99.9	99.9
At Least Two	99.6	99.6	99.7
All Three	96.3	96.5	97.2

3.4 Handling Troublesome Images

3.4.1 Capture Failures

Segmentation algorithms may refuse to process an image. This may happen for a technical reason (e.g., the algorithm cannot parse the image data), or for a practical reason (e.g., the hand in the image is placed incorrectly). These failure scenarios are the result of capturing improper image data. In these types of scenarios, it is important to examine the cause of the failure. With many live scan capture setups, segmentation is performed immediately after capture. If an algorithm can detect that it won't be able to segment an image due to a technical or practical issue, it can alert the operator to perform a recapture before the subject leaves.

The SlapSeg III API encourages algorithms to identify these failure reasons by specifying pre-defined *deficiencies* in the image. Algorithms should attempt segmentation even if an image deficiency is encountered if at all possible. Note that SlapSeg III *guarantees* well-formed image data, so failures to parse are **not** an indicator of the data provided.

`TigerImp+0002` did **not** report any capture failures.

3.4.1.1 Recovery

When encountering a segmentation failure, SlapSeg III algorithms are encouraged to provide a *best-effort* segmentation when possible. In some cases, that best-effort may be correct, which reduces the amount of images that need to be manually adjudicated by an operator.

`TigerImp+0002` did not attempt any recovery segmentations.

3.4.2 Segmentation Failures

Even if an algorithm accepts an image for processing, it can still fail to process one or more fingers from the image, regardless of if the algorithm requested a recapture and provided best-effort segmentation.

The SlapSeg III API allows algorithms to communicate reasons for failure to process these fingers. In some cases, the distal phalanx in question might not be present in the image due to amputation or being placed outside the platen's capture area. It is imperative that the segmentation algorithm correctly report this as failing to segment the correct friction ridge generalized position without disrupting the sequence of valid positions present in the image. This can help prompt an operator to recapture or record additional information about the subject.

In SlapSeg III, a number of images are missing fingers or otherwise have fingers that will not be able to be segmented. Reasons for segmentation failures reported by `TigerImp+0002` are enumerated in Table 18.

Table 18: Count of self-reported segmentation failure reasoning.

Failure Reason	Fingers
Finger Not Found	564
Finger Found, but Can't Segment	0
Vendor Defined	0

3.4.3 Identifying Missing Fingers

A small portion of the test corpus in SlapSeg III are missing fingers. Table 19 shows how successful `TigerImp+0002` was in correctly determining if a finger was missing. The *Missed* row shows when a segmentation position was returned for a missing finger. All possible failure reasons are enumerated, but are not considered *Correctly Identified* because the algorithm specified failure for a reason other than the finger not being found.

Table 19: Performance of TigerImp+0002 at detecting fingers missing from an image.

Result	Percentage
Missed	24.1
Correctly Identified	75.9
Other Failure: Finger Found, but Can't Segment	0.0
Other Failure: Vendor Defined	0.0
Other Failure: Segmentation Not Attempted	0.0

3.4.4 Sequence Error

Sequence error occurs when a fingerprint is segmented from an image but assigned an incorrect finger position (e.g., segmenting a right middle finger but labeling it a right index finger). Table 20 shows cases in which a segmentation position was returned that matched a ground truth segmentation position for a different finger in the same image.

Table 20: Percentage of images in the dataset where one or more segmentation positions correctly matched an incorrect finger position within the same image, indicating sequence error.

Hand	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Left	0.07	0.07	0.07
Right	0.06	0.06	0.06
Thumbs	0.03	0.03	0.03
Combined	0.05	0.05	0.06

4 Upper Palm ("FiveInch" Data)

4.1 Segmentation Timing

All algorithms are run over a small fixed corpus of FiveInch images to estimate the total runtime of the evaluation. To be evaluated under SlapSeg III, algorithms **must** segment the timing corpus, on average, in under 1 500 milliseconds. This maximum reference time is documented in the SlapSeg III test plan, and is subject to change. Times are measured by running a single process on an isolated compute node equipped with an Intel Gold 6254 CPU (submissions received prior to February 2022 were timed with a Intel Xeon E5-4650 CPU).

Box plots of segmentation times are separated by slap orientation in Figure 13. Tabular representations are enumerated in Table 21. Results are reported in milliseconds.

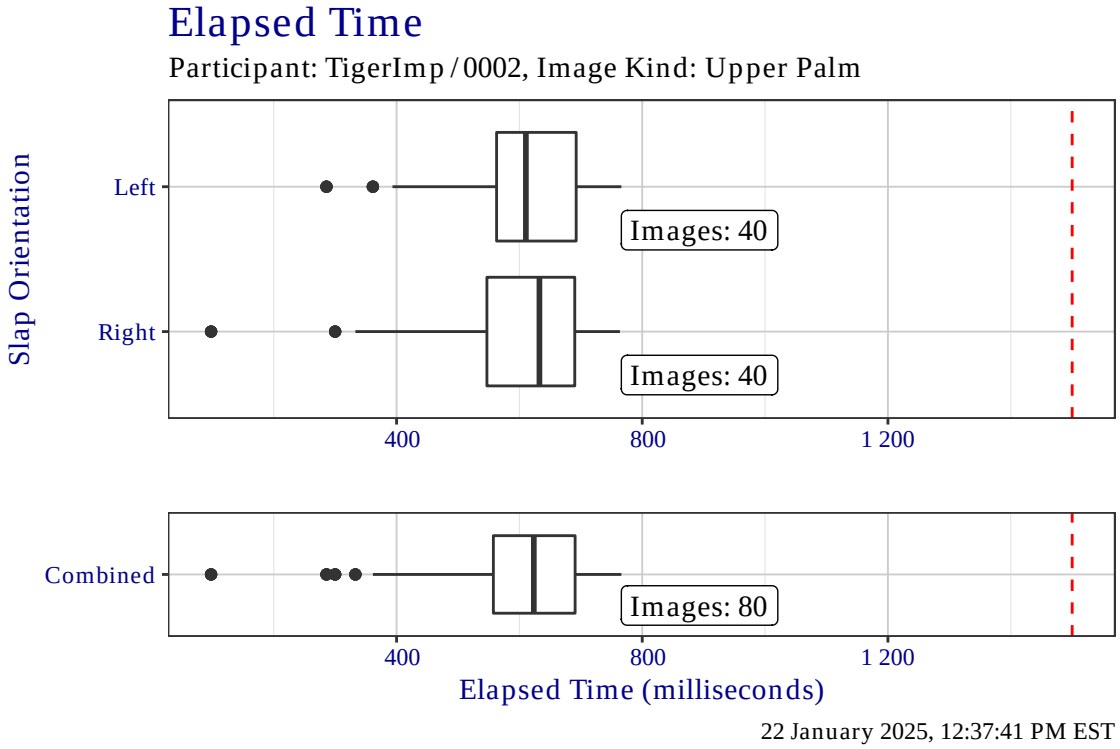

Figure 13: Box plots of elapsed time in milliseconds when segmenting the FiveInch timing test corpus, separated by slap orientation.

Table 21: Elapsed time in milliseconds when segmenting the FiveInch timing test corpus, separated by slap orientation.

	Right	Left	Combined
Minimum	98	286	98
25%	547	563	558
Median	633	611	624
75%	690	692	691
Maximum	764	766	766

4.2 Segmentation Centers and Dimensions

4.2.1 Segmentation Centers

The plots in this section show the distribution of segmentation position centers (x, y) for FiveInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation centers for the right hand FiveInch data are shown in Figure 14 and plots of segmentation centers for the left hand are shown in Figure 15. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Centers have been normalized to 500 pixels per inch.

Points in each plot are plotted with a semi-transparent opacity. This results in points of particular color appearing "darker" to indicate a higher frequency of the observed value, while "lighter" points indicate a lower observed frequency.

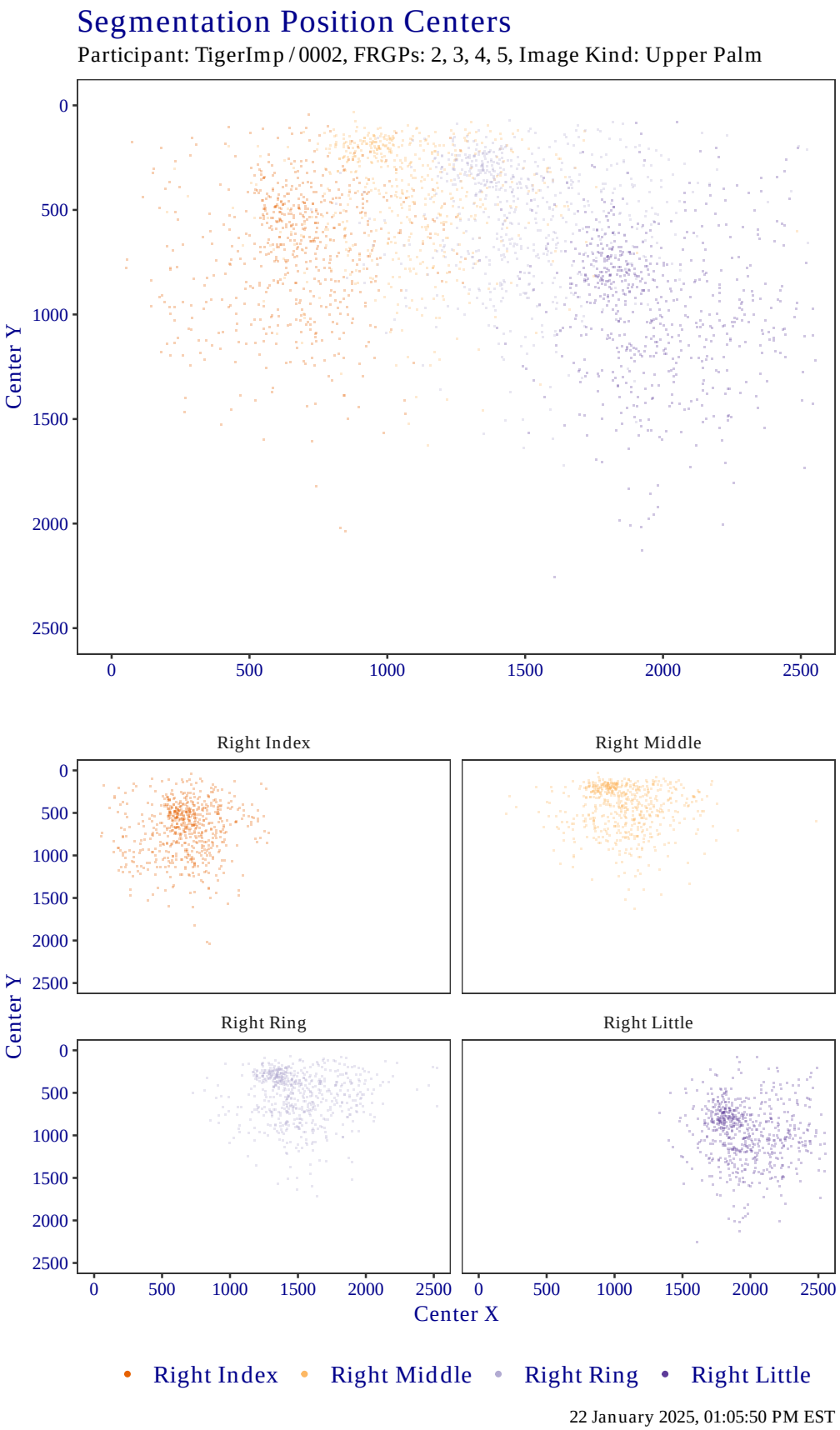

Figure 14: Segmentation centers for right hand FiveInch data.

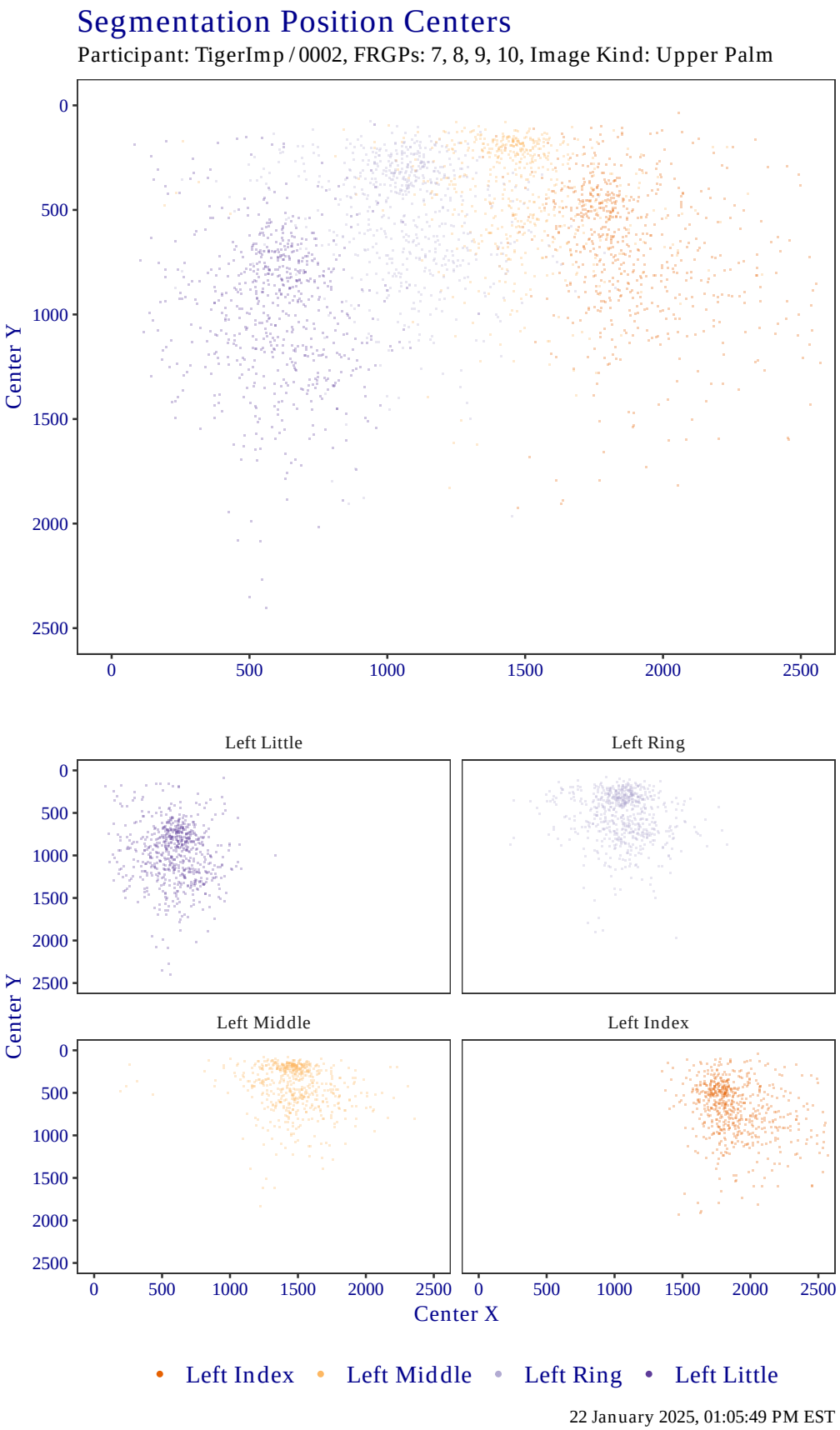

Figure 15: Segmentation centers for left hand FiveInch data.

4.2.2 Segmentation Dimensions

The plots in this section show the distribution of segmentation position widths and heights for FiveInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation position dimensions for the right hand FiveInch data are shown in Figure 16 and the left hand in Figure 17. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Dimensions have been normalized to 500 pixels per inch.

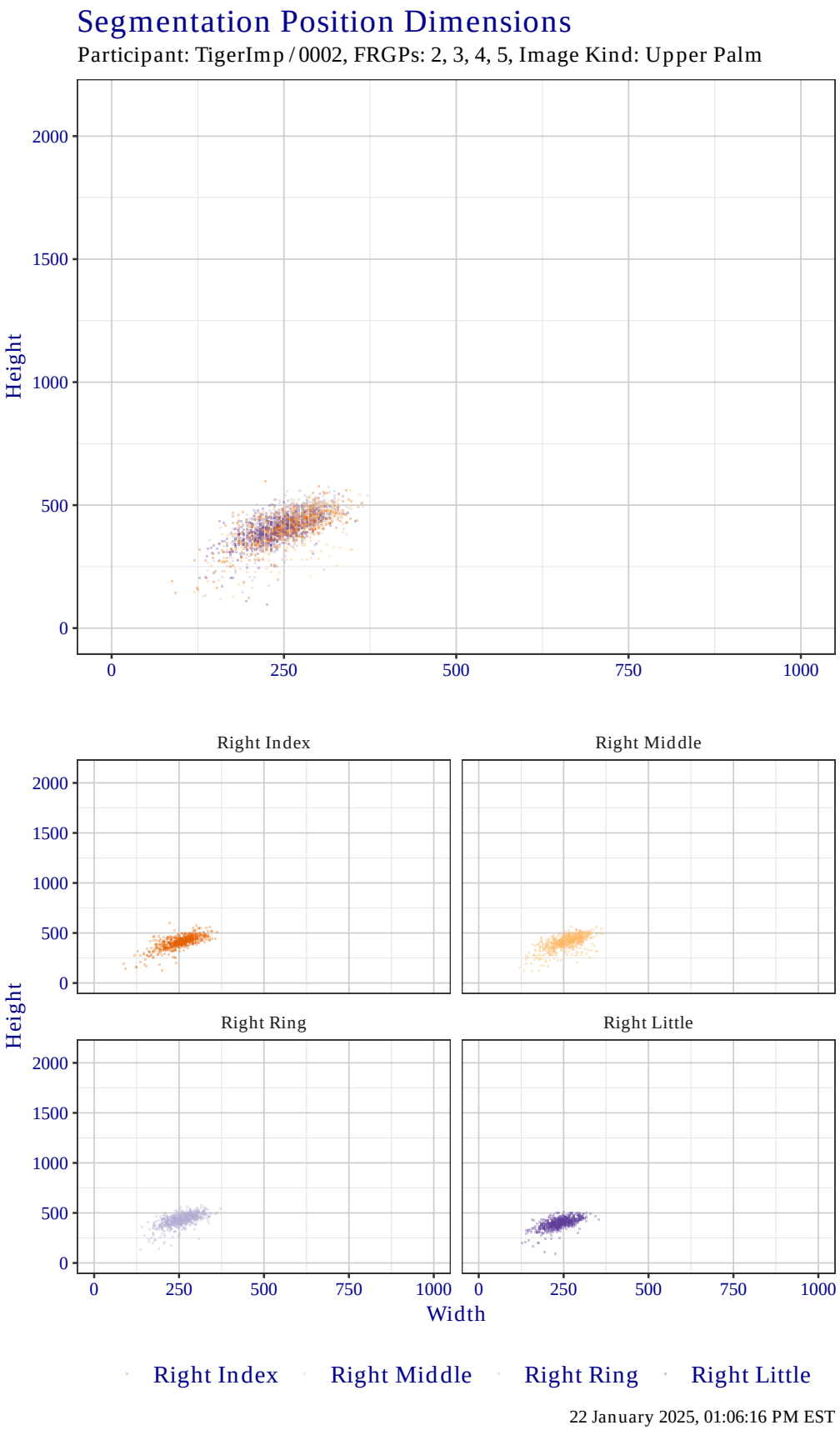

Figure 16: Segmentation position dimensions for right hand FiveInch data.

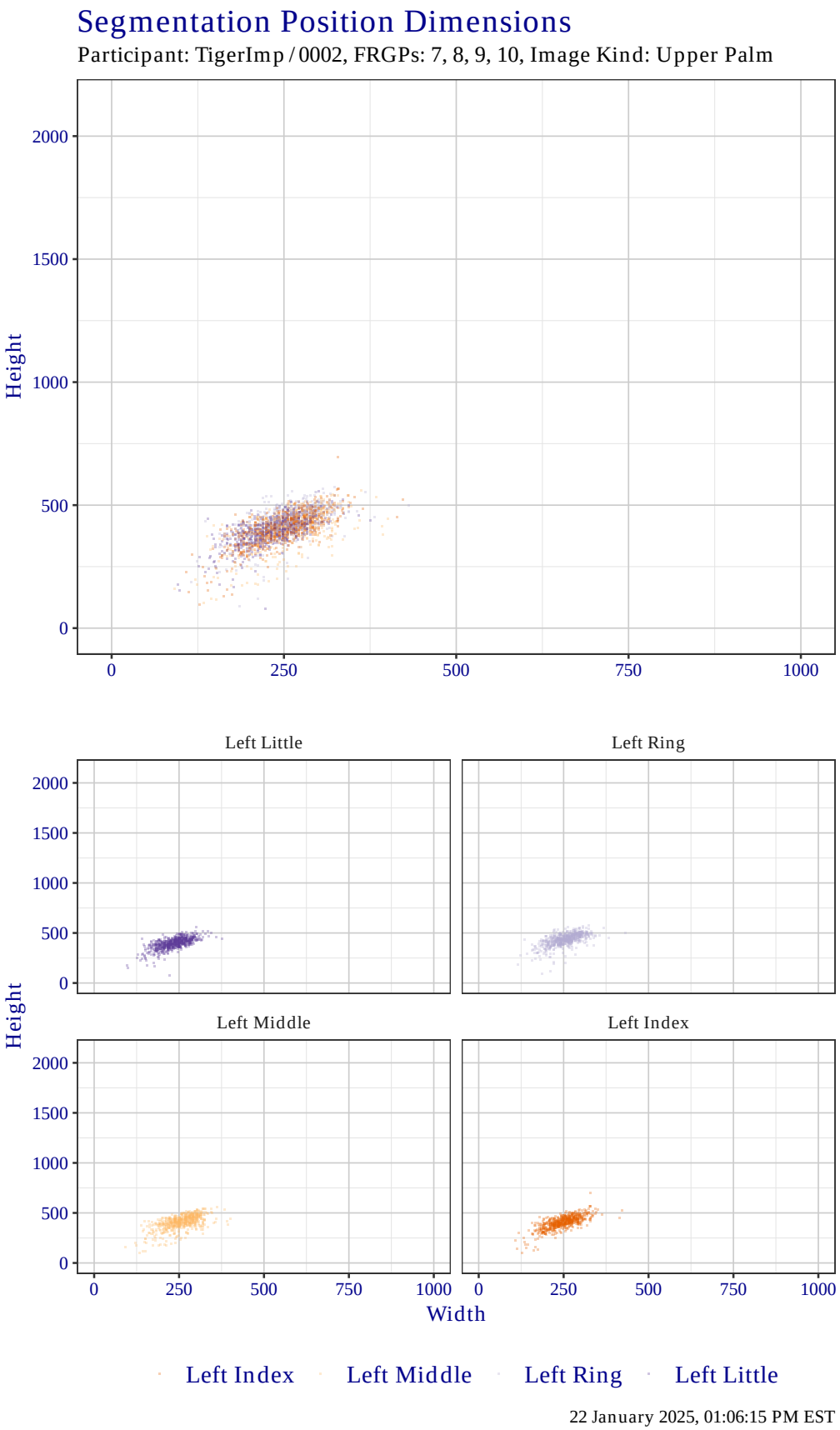

Figure 17: Segmentation position dimensions for left hand FiveInch data.

4.3 Detailed Segmentation Statistics

This section shows detailed results of segmentation of FiveInch data. Values in each table are the percentage that the variable in the left-most column was correctly segmented.

Each table has three columns of percentages. The *Standard Scoring* column shows the percentage of correctly-segmented positions based on the scoring metrics defined in the SlapSeg III scoring document. The *Ignoring Bottom Y* column shows how the percentage would change if the threshold for the *bottom Y* coordinate of the segmentation position was ignored. Similarly, the *Ignoring Bottom X and Y* columns shows how the percentage would change if only the top, left, and right sides of the segmentation position were considered. These two supplemental columns are included because it has traditionally been difficult to determine the exact location of the distal interphalangeal joint.

Table 22 shows how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 23 shows success for specific finger positions over the entire test corpus. Similarly, Table 24 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers on each slap image. Table 25 shows success for combinations of all fingers, Table 26 for just the index and middle fingers, and Table 27 for all except the little finger.

Table 22: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.3	99.3	99.3
2	99.2	99.2	99.2
3	98.0	98.2	98.2
4	95.9	96.0	96.3
5	91.4	91.7	91.8
6	83.8	84.1	84.5
7	71.7	72.2	74.3
8	47.0	47.4	51.3

Table 23: For all subjects, percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	88.7	88.8	88.8
Middle	89.1	89.5	91.4
Ring	91.0	91.1	91.5
Little	83.9	83.9	85.1
Left			
Index	84.6	85.1	85.4
Middle	88.3	88.5	88.9
Ring	89.4	89.7	89.9
Little	76.9	77.1	79.4

Table 24: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	95.9	96.0	96.0
Both	76.0	76.5	76.8
Middle			
Either	96.7	96.8	97.4
Both	79.3	79.7	81.4
Ring			
Either	97.5	97.6	97.6
Both	81.4	81.7	82.3
Little			
Either	94.7	94.7	95.4
Both	64.8	65.0	67.9

Table 25: Percentage of segmentation success by hand for combinations of all eight fingers of a FiveInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.3	98.3	98.3
At Least Two	95.9	95.9	96.0
At Least Three	88.8	89.1	89.4
All Four	69.7	70.1	73.1
Left			
Any	97.3	97.5	97.5
At Least Two	93.8	93.8	94.0
At Least Three	85.3	85.4	85.8
All Four	62.9	63.7	66.3

Table 26: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	95.6	95.7	96.0
Both Index and Middle	82.2	82.6	84.2
Left			
Either Index or Middle	93.8	93.8	93.9
Both Index and Middle	79.2	79.8	80.4

Table 27: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	97.5	97.5	97.5
At Least Two	93.8	93.9	94.1
All Three	77.5	78.1	80.1
Left			
Any	96.6	96.7	96.7
At Least Two	90.7	90.7	90.8
All Three	75.1	75.9	76.7

4.4 Handling Troublesome Images

4.4.1 Capture Failures

Segmentation algorithms may refuse to process an image. This may happen for a technical reason (e.g., the algorithm cannot parse the image data), or for a practical reason (e.g., the hand in the image is placed incorrectly). These failure scenarios are the result of capturing improper image data. In these types of scenarios, it is important to examine the cause of the failure. With many live scan capture setups, segmentation is performed immediately after capture. If an algorithm can detect that it won't be able to segment an image due to a technical or practical issue, it can alert the operator to perform a recapture before the subject leaves.

The SlapSeg III API encourages algorithms to identify these failure reasons by specifying pre-defined *deficiencies* in the image. Algorithms should attempt segmentation even if an image deficiency is encountered if at all possible. Note that SlapSeg III *guarantees* well-formed image data, so failures to parse are **not** an indicator of the data provided.

`TigerImp+0002` did **not** report any capture failures.

4.4.1.1 Recovery

When encountering a segmentation failure, SlapSeg III algorithms are encouraged to provide a *best-effort* segmentation when possible. In some cases, that best-effort may be correct, which reduces the amount of images that need to be manually adjudicated by an operator.

`TigerImp+0002` did not attempt any recovery segmentations.

4.4.2 Segmentation Failures

Even if an algorithm accepts an image for processing, it can still fail to process one or more fingers from the image, regardless of if the algorithm requested a recapture and provided best-effort segmentation.

The SlapSeg III API allows algorithms to communicate reasons for failure to process these fingers. In some cases, the distal phalanx in question might not be present in the image due to amputation or being placed outside the platen's capture area. It is imperative that the segmentation algorithm correctly report this as failing to segment the correct friction ridge generalized position without disrupting the sequence of valid positions present in the image. This can help prompt an operator to recapture or record additional information about the subject.

In SlapSeg III, a number of images are missing fingers or otherwise have fingers that will not be able to be segmented. Reasons for segmentation failures reported by `TigerImp+0002` are enumerated in Table 28.

Table 28: Count of self-reported segmentation failure reasoning.

Failure Reason	Fingers
Finger Not Found	1 126
Finger Found, but Can't Segment	0
Vendor Defined	0

4.4.3 Identifying Missing Fingers

A small portion of the test corpus in SlapSeg III are missing fingers. Table 29 shows how successful `TigerImp+0002` was in correctly determining if a finger was missing. The *Missed* row shows when a segmentation position was returned for a missing finger. All possible failure reasons are enumerated, but are not considered *Correctly Identified* because the algorithm specified failure for a reason other than the finger not being found.

Table 29: Performance of TigerImp+0002 at detecting fingers missing from an image.

Result	Percentage
Missed	11.5
Correctly Identified	88.5
Other Failure: Finger Found, but Can't Segment	0.0
Other Failure: Vendor Defined	0.0
Other Failure: Segmentation Not Attempted	0.0

4.4.4 Sequence Error

Sequence error occurs when a fingerprint is segmented from an image but assigned an incorrect finger position (e.g., segmenting a right middle finger but labeling it a right index finger). Table 30 shows cases in which a segmentation position was returned that matched a ground truth segmentation position for a different finger in the same image.

Table 30: Percentage of images in the dataset where one or more segmentation positions correctly matched an incorrect finger position within the same image, indicating sequence error.

Hand	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Left	6.50	6.63	6.63
Right	5.72	5.72	5.85
Combined	6.11	6.18	6.24

5 Full Palm ("EightInch" Data)

5.1 Segmentation Timing

All algorithms are run over a small fixed corpus of EightInch images to estimate the total runtime of the evaluation. To be evaluated under SlapSeg III, algorithms **must** segment the timing corpus, on average, in under 1 500 milliseconds. This maximum reference time is documented in the SlapSeg III test plan, and is subject to change. Times are measured by running a single process on an isolated compute node equipped with an Intel Gold 6254 CPU (submissions received prior to February 2022 were timed with a Intel Xeon E5-4650 CPU).

Box plots of segmentation times are separated by slap orientation in Figure 18. Tabular representations are enumerated in Table 31. Results are reported in milliseconds.

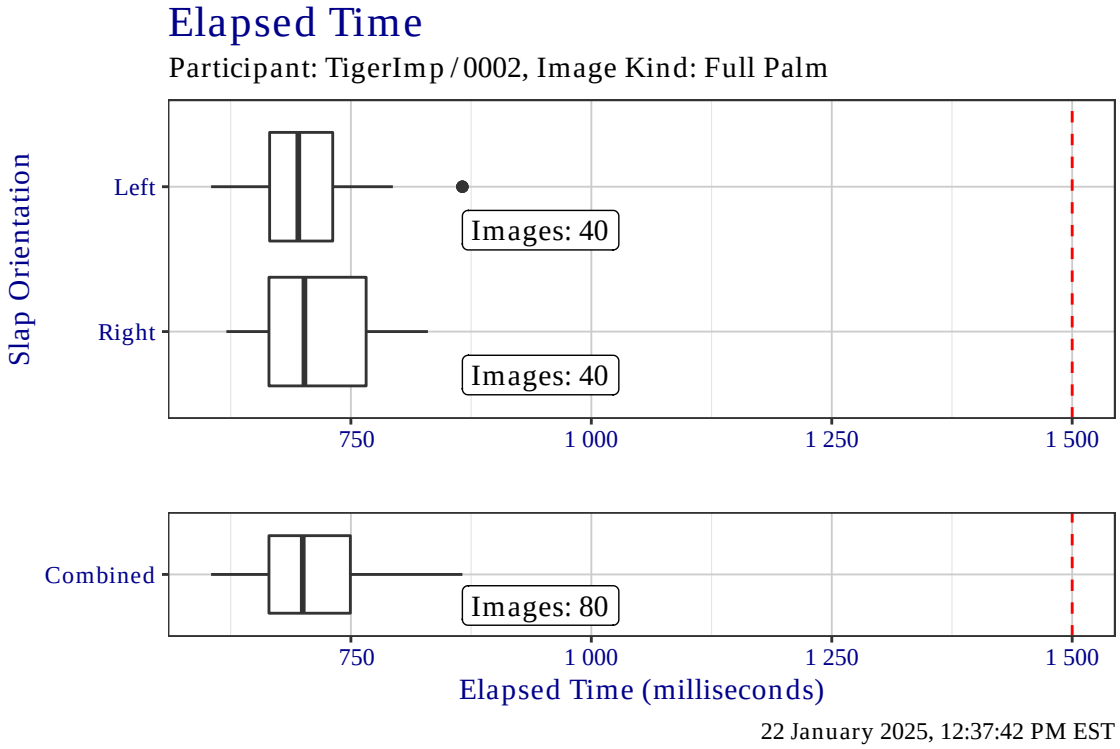

Figure 18: Box plots of elapsed time in milliseconds when segmenting the EightInch timing test corpus, separated by slap orientation.

Table 31: Elapsed time in milliseconds when segmenting the EightInch timing test corpus, separated by slap orientation and capture technology.

	Right	Left	Combined
Minimum	621	605	605
25%	665	666	665
Median	702	695	700
75%	766	731	749
Maximum	830	866	866

5.2 Segmentation Centers and Dimensions

5.2.1 Segmentation Centers

The plots in this section show the distribution of segmentation position centers (x, y) for EightInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation centers for the right hand EightInch data are shown in Figure 19 and plots of segmentation centers for the left hand are shown in Figure 20. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Centers have been normalized to 500 pixels per inch.

Points in each plot are plotted with a semi-transparent opacity. This results in points of particular color appearing "darker" to indicate a higher frequency of the observed value, while "lighter" points indicate a lower observed frequency.

Figure 19: Segmentation centers for right hand EightInch data.

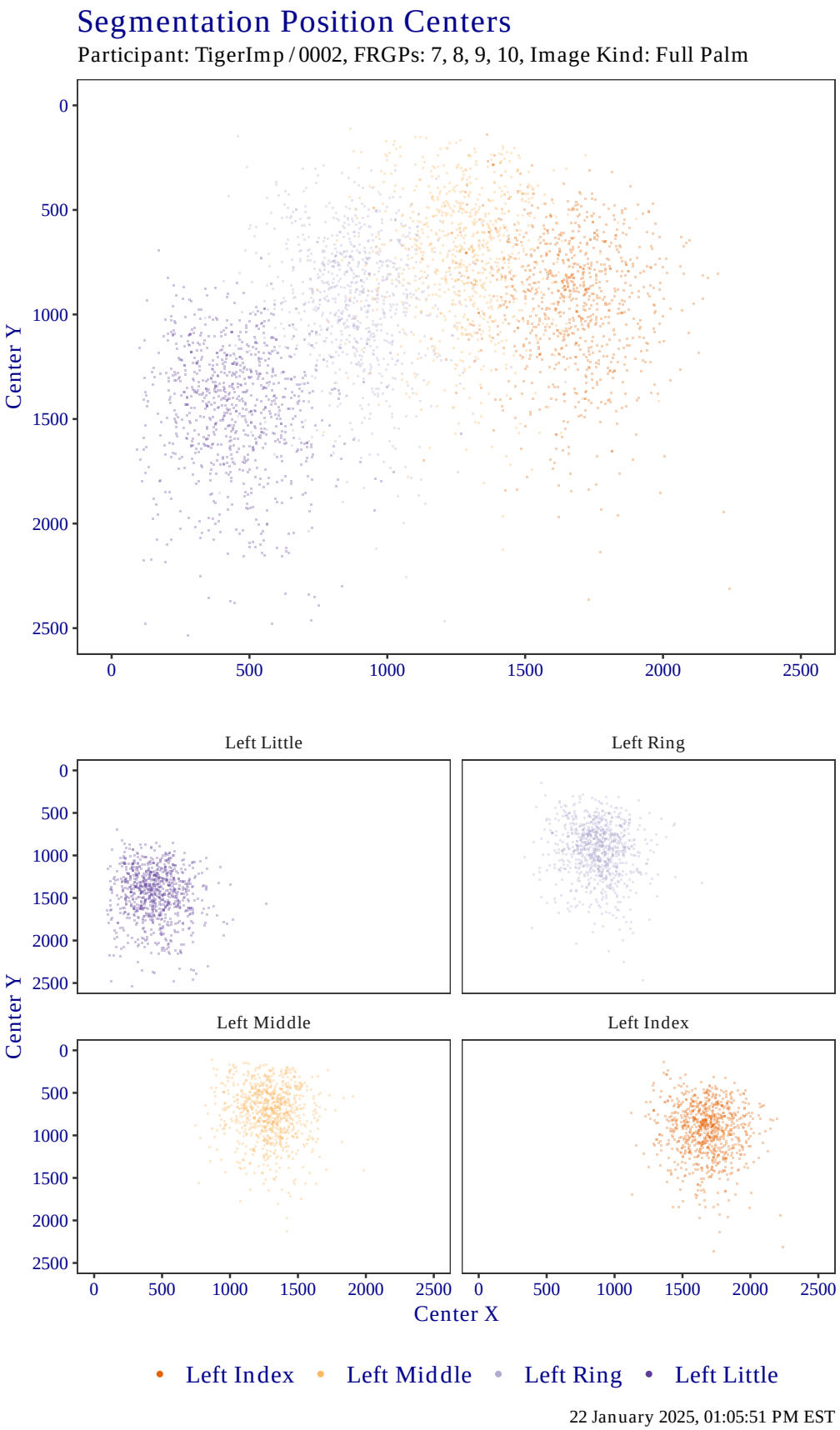

Figure 20: Segmentation centers for left hand EightInch data.

5.2.2 Segmentation Dimensions

The plots in this section show the distribution of segmentation position widths and heights for EightInch data. At the top of each figure is a combined plot for all finger positions of a given slap orientation. These figures are isolated in plots faceted at the bottom of the figure.

Plots of segmentation position dimensions for the right hand EightInch data are shown in Figure 21 and the left hand in Figure 22. Blank lines that may appear in the plots are **not** rendering artifacts. Rather, they are indicative of image downsampling. Dimensions have been normalized to 500 pixels per inch.

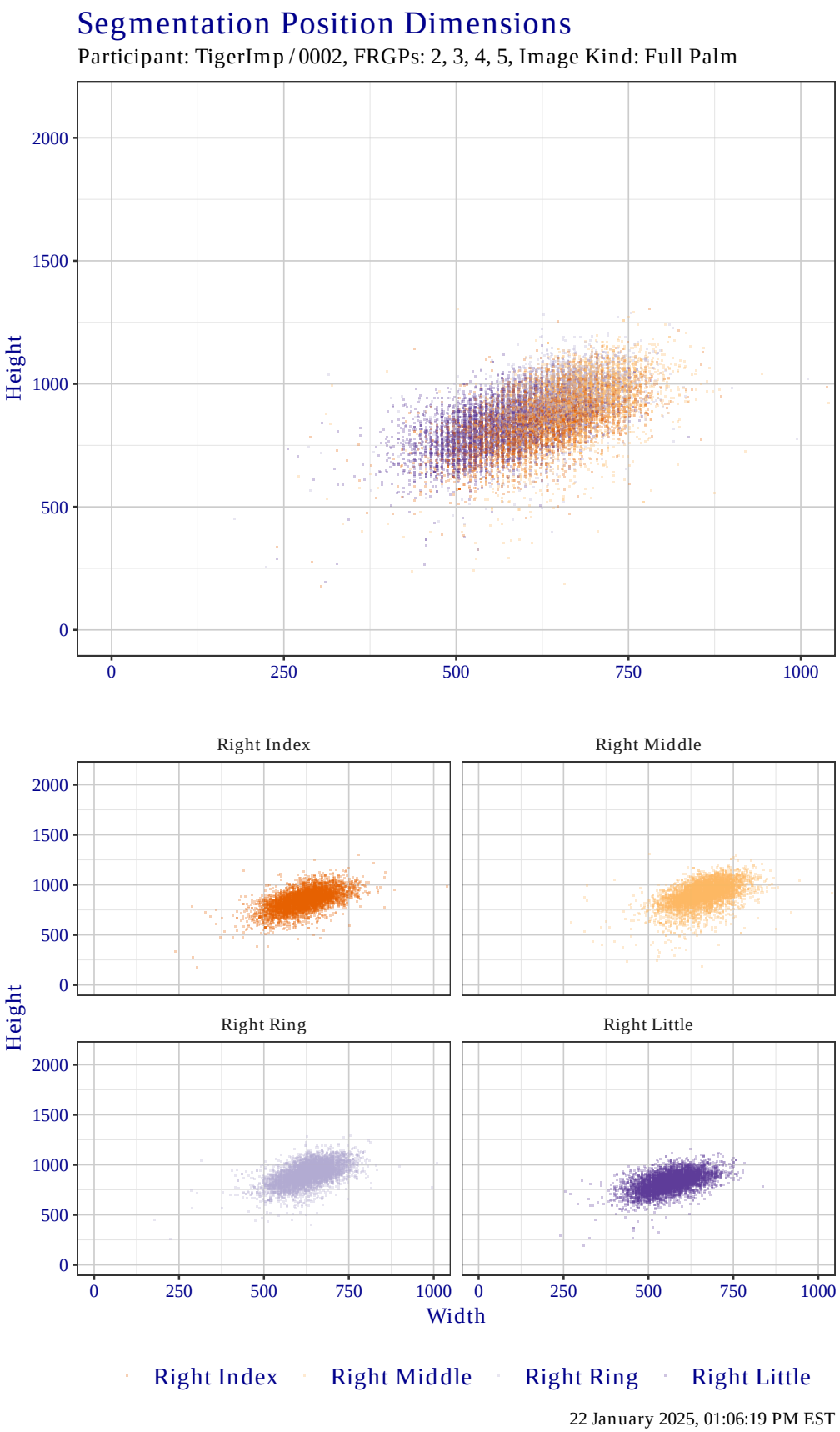

Figure 21: Segmentation position dimensions for right hand EightInch data.

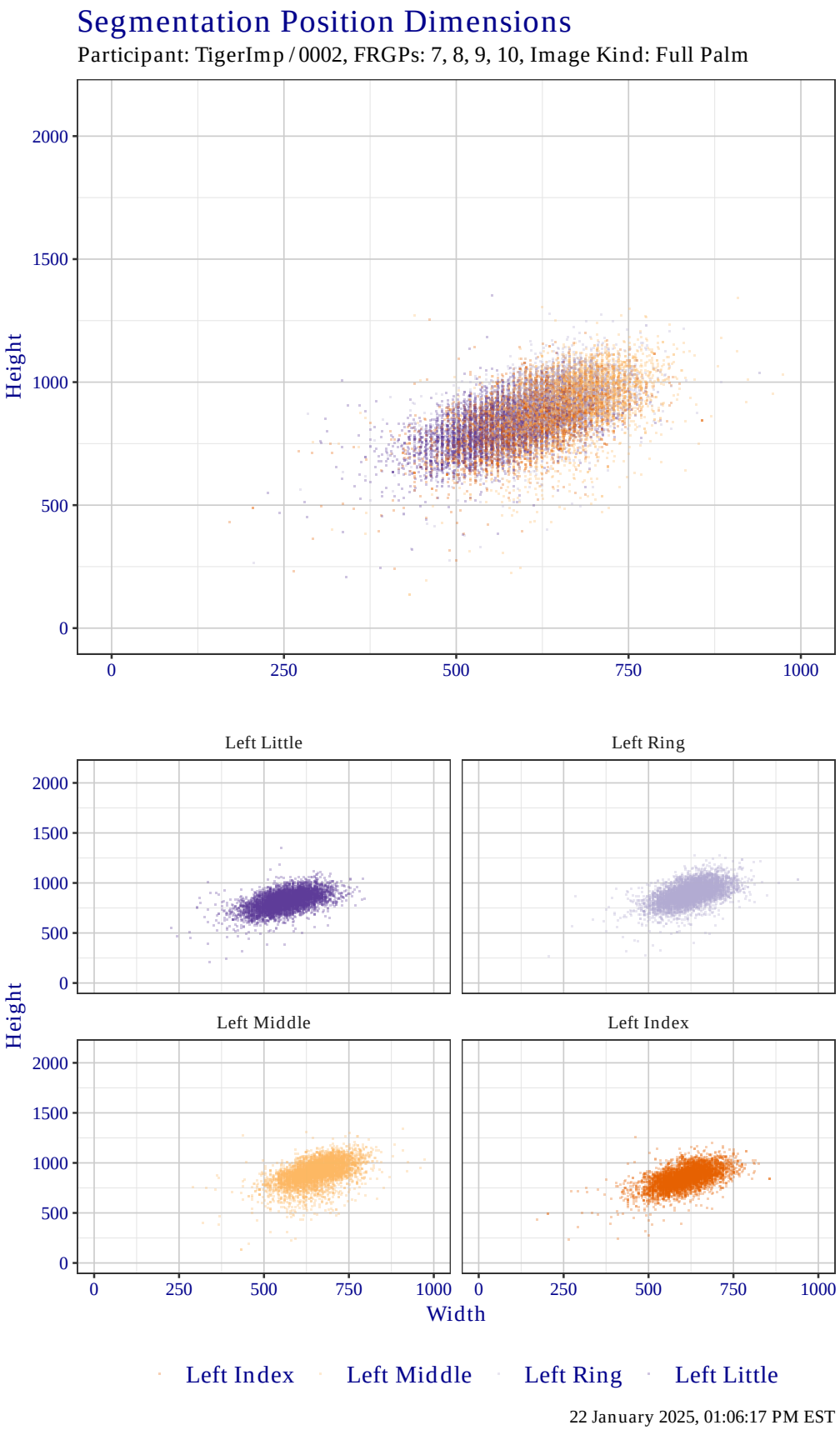

Figure 22: Segmentation position dimensions for left hand EightInch data.

5.3 Detailed Segmentation Statistics

NOTE: *The following segmentation statistics are based on a limited subset (approximately 15%) of the anticipated Full Palm dataset. This analysis will be updated as soon as NIST can obtain the remainder of the dataset.*

This section shows detailed results of segmentation of EightInch data. Values in each table are the percentage that the variable in the left-most column was correctly segmented.

Each table has three columns of percentages. The *Standard Scoring* column shows the percentage of correctly-segmented positions based on the scoring metrics defined in the SlapSeg III scoring document. The *Ignoring Bottom Y* column shows how the percentage would change if the threshold for the *bottom Y* coordinate of the segmentation position was ignored. Similarly, the *Ignoring Bottom X and Y* columns shows how the percentage would change if only the top, left, and right sides of the segmentation position were considered. These two supplemental columns are included because it has traditionally been difficult to determine the exact location of the distal interphalangeal joint.

Table 32 shows how successful TigerImp+0002 segmented fingers for each subject in the test corpus. Table 33 shows success for specific finger positions over the entire test corpus. Similarly, Table 34 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers on each slap image. Table 35 shows success for combinations of all fingers, Table 36 for just the index and middle fingers, and Table 37 for all except the little finger.

Table 32: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.9	99.9	99.9
2	99.9	99.9	99.9
3	99.9	99.9	99.9
4	99.0	99.0	99.2
5	98.0	98.0	98.0
6	96.7	96.9	97.1
7	94.5	94.6	95.3
8	80.8	82.1	83.0

Table 33: For all subjects, percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	96.7	96.8	96.9
Middle	96.6	96.6	96.9
Ring	96.1	96.6	96.9
Little	94.6	94.9	95.2
Left			
Index	97.4	97.4	97.5
Middle	97.4	97.4	97.4
Ring	96.2	96.7	97.2
Little	93.8	94.0	94.4

Table 34: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	99.8	99.8	99.9
Both	94.3	94.4	94.5
Middle			
Either	99.7	99.7	99.8
Both	94.3	94.3	94.5
Ring			
Either	99.4	99.5	99.7
Both	92.9	93.7	94.5
Little			
Either	99.1	99.1	99.1
Both	89.3	89.9	90.5

Table 35: Percentage of segmentation success by hand for combinations of all eight fingers of a EightInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.9	98.9	98.9
At Least Two	98.7	98.7	98.7
At Least Three	97.6	97.7	98.0
All Four	88.7	89.5	90.2
Left			
Any	99.1	99.1	99.1
At Least Two	98.7	98.7	98.9
At Least Three	97.9	98.0	98.2
All Four	89.0	89.5	90.3

Table 36: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	98.7	98.7	98.7
Both Index and Middle	94.5	94.6	95.1
Left			
Either Index or Middle	99.1	99.1	99.1
Both Index and Middle	95.6	95.6	95.7

Table 37: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.9	98.9	98.9
At Least Two	98.3	98.3	98.5
All Three	92.2	92.8	93.3
Left			
Any	99.1	99.1	99.1
At Least Two	98.5	98.5	98.6
All Three	93.3	93.8	94.4

5.4 Handling Troublesome Images

5.4.1 Capture Failures

Segmentation algorithms may refuse to process an image. This may happen for a technical reason (e.g., the algorithm cannot parse the image data), or for a practical reason (e.g., the hand in the image is placed incorrectly). These failure scenarios are the result of capturing improper image data. In these types of scenarios, it is important to examine the cause of the failure. With many live scan capture setups, segmentation is performed immediately after capture. If an algorithm can detect that it won't be able to segment an image due to a technical or practical issue, it can alert the operator to perform a recapture before the subject leaves.

The SlapSeg III API encourages algorithms to identify these failure reasons by specifying pre-defined *deficiencies* in the image. Algorithms should attempt segmentation even if an image deficiency is encountered if at all possible. Note that SlapSeg III *guarantees* well-formed image data, so failures to parse are **not** an indicator of the data provided.

`TigerImp+0002` did **not** report any capture failures.

5.4.1.1 Recovery

When encountering a segmentation failure, SlapSeg III algorithms are encouraged to provide a *best-effort* segmentation when possible. In some cases, that best-effort may be correct, which reduces the amount of images that need to be manually adjudicated by an operator.

`TigerImp+0002` did not attempt any recovery segmentations.

5.4.2 Segmentation Failures

Even if an algorithm accepts an image for processing, it can still fail to process one or more fingers from the image, regardless of if the algorithm requested a recapture and provided best-effort segmentation.

The SlapSeg III API allows algorithms to communicate reasons for failure to process these fingers. In some cases, the distal phalanx in question might not be present in the image due to amputation or being placed outside the platen's capture area. It is imperative that the segmentation algorithm correctly report this as failing to segment the correct friction ridge generalized position without disrupting the sequence of valid positions present in the image. This can help prompt an operator to recapture or record additional information about the subject.

In SlapSeg III, a number of images are missing fingers or otherwise have fingers that will not be able to be segmented. Reasons for segmentation failures reported by `TigerImp+0002` are enumerated in Table 38.

Table 38: Count of self-reported segmentation failure reasoning.

Failure Reason	Fingers
Finger Not Found	330
Finger Found, but Can't Segment	0
Vendor Defined	0

5.4.3 Identifying Missing Fingers

A small portion of the test corpus in SlapSeg III are missing fingers. Table 39 shows how successful `TigerImp+0002` was in correctly determining if a finger was missing. The *Missed* row shows when a segmentation position was returned for a missing finger. All possible failure reasons are enumerated, but are not considered *Correctly Identified* because the algorithm specified failure for a reason other than the finger not being found.

Table 39: Performance of TigerImp+0002 at detecting fingers missing from an image.

Result	Percentage
Missed	0.0
Correctly Identified	100.0
Other Failure: Finger Found, but Can't Segment	0.0
Other Failure: Vendor Defined	0.0
Other Failure: Segmentation Not Attempted	0.0

5.4.4 Sequence Error

Sequence error occurs when a fingerprint is segmented from an image but assigned an incorrect finger position (e.g., segmenting a right middle finger but labeling it a right index finger). Table 40 shows cases in which a segmentation position was returned that matched a ground truth segmentation position for a different finger in the same image.

Table 40: Percentage of images in the dataset where one or more segmentation positions correctly matched an incorrect finger position within the same image, indicating sequence error.

Hand	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Left	1.03	1.03	1.03
Right	0.92	1.03	1.03
Combined	0.98	1.03	1.03

A Tenprint Cards ("TwoInch" Data)

A.1 Bootstrap Confidence for Segmentation Statistics

This section shows the same detailed results of segmentation of TwoInch data from Section 2.3, but with an added bootstrap confidence interval. For each observation, a bootstrap routine with 1 000 replicates was run, and a 95 % confidence interval extracted. The lower and upper confidence from that confidence interval are printed in each column within square brackets.

In Table 41, results are shown of how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 42 shows success for specific finger positions over the entire test corpus. Similarly, Table 43 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers in each slap image. Table 44 shows success for combinations of all fingers, Table 46 for the all except the little finger, and Table 45 for just the index and middle fingers.

Table 41: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.9 [99.8, 99.9]	99.9 [99.8, 99.9]	99.9 [99.8, 100.0]
2	99.8 [99.7, 99.9]	99.8 [99.7, 99.9]	99.8 [99.8, 99.9]
3	99.5 [99.4, 99.6]	99.5 [99.4, 99.6]	99.6 [99.5, 99.7]
4	98.8 [98.6, 99.0]	98.9 [98.7, 99.1]	99.0 [98.8, 99.2]
5	95.0 [94.6, 95.4]	95.1 [94.7, 95.4]	95.2 [94.9, 95.6]
6	94.4 [94.0, 94.8]	94.6 [94.2, 95.0]	94.9 [94.5, 95.2]
7	92.8 [92.4, 93.3]	93.4 [92.9, 93.8]	93.8 [93.3, 94.2]
8	83.6 [82.9, 84.2]	86.6 [86.0, 87.2]	87.3 [86.7, 87.9]

Table 42: For all subjects, Percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	95.8 [95.6, 96.1]	96.9 [96.6, 97.1]	97.1 [96.9, 97.3]
Middle	97.5 [97.3, 97.7]	98.0 [97.8, 98.2]	98.2 [98.0, 98.4]
Ring	97.8 [97.6, 98.0]	98.2 [98.0, 98.4]	98.4 [98.3, 98.6]
Little	97.9 [97.7, 98.1]	98.5 [98.3, 98.6]	98.8 [98.6, 98.9]
Left			
Index	97.1 [96.9, 97.4]	97.6 [97.4, 97.8]	97.7 [97.5, 97.9]
Middle	97.4 [97.2, 97.6]	97.9 [97.7, 98.1]	98.1 [97.9, 98.3]
Ring	97.8 [97.6, 98.0]	98.4 [98.2, 98.5]	98.5 [98.3, 98.7]
Little	98.1 [97.9, 98.2]	98.4 [98.2, 98.5]	98.6 [98.4, 98.7]

Table 43: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	99.3 [99.2, 99.5]	99.4 [99.3, 99.5]	99.4 [99.3, 99.6]
Both	89.9 [89.4, 90.4]	91.1 [90.6, 91.6]	91.5 [91.0, 92.0]
Middle			
Either	99.4 [99.2, 99.5]	99.5 [99.3, 99.6]	99.5 [99.4, 99.6]
Both	91.7 [91.2, 92.1]	92.5 [92.1, 93.0]	92.8 [92.4, 93.3]
Ring			
Either	99.5 [99.4, 99.6]	99.6 [99.5, 99.7]	99.6 [99.5, 99.7]
Both	92.3 [91.8, 92.7]	93.2 [92.8, 93.7]	93.5 [93.1, 93.9]
Little			
Either	99.4 [99.2, 99.5]	99.4 [99.3, 99.5]	99.5 [99.4, 99.6]
Both	92.4 [91.9, 92.9]	93.1 [92.7, 93.6]	93.6 [93.2, 94.0]

Table 44: Percentage of segmentation success by hand for combinations of all eight fingers of a TwoInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.5 [99.4, 99.6]	99.5 [99.5, 99.6]	99.6 [99.5, 99.6]
At Least Two	99.3 [99.2, 99.3]	99.3 [99.2, 99.4]	99.5 [99.4, 99.5]
At Least Three	98.5 [98.4, 98.6]	98.7 [98.6, 98.8]	99.0 [98.8, 99.0]
All Four	91.6 [92.1, 92.6]	94.0 [94.1, 94.6]	94.4 [94.5, 95.0]
Left			
Any	99.5 [99.4, 99.6]	99.5 [99.5, 99.6]	99.6 [99.5, 99.6]
At Least Two	99.2 [99.2, 99.3]	99.3 [99.2, 99.4]	99.4 [99.4, 99.5]
At Least Three	98.5 [98.4, 98.6]	98.7 [98.6, 98.8]	98.8 [98.8, 99.0]
All Four	93.2 [92.1, 92.6]	94.8 [94.1, 94.6]	95.1 [94.5, 95.0]

Table 45: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	99.1 [99.0, 99.2]	99.2 [99.1, 99.3]	99.3 [99.2, 99.4]
Both Index and Middle	94.2 [94.6, 95.0]	95.7 [95.8, 96.2]	96.0 [96.1, 96.4]
Left			
Either Index or Middle	99.0 [99.0, 99.2]	99.1 [99.1, 99.3]	99.2 [99.2, 99.4]
Both Index and Middle	95.5 [94.6, 95.0]	96.4 [95.8, 96.2]	96.6 [96.1, 96.4]

Table 46: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.4 [99.3, 99.5]	99.5 [99.4, 99.5]	99.6 [99.5, 99.6]
At Least Two	98.8 [98.6, 98.8]	98.9 [98.8, 99.0]	99.2 [99.0, 99.2]
All Three	92.9 [93.3, 93.8]	94.7 [94.9, 95.4]	95.0 [95.2, 95.6]
Left			
Any	99.4 [99.3, 99.5]	99.4 [99.4, 99.5]	99.5 [99.5, 99.6]
At Least Two	98.7 [98.6, 98.8]	98.8 [98.8, 99.0]	99.0 [99.0, 99.2]
All Three	94.3 [93.3, 93.8]	95.6 [94.9, 95.4]	95.8 [95.2, 95.6]

A.2 Jaccard Index

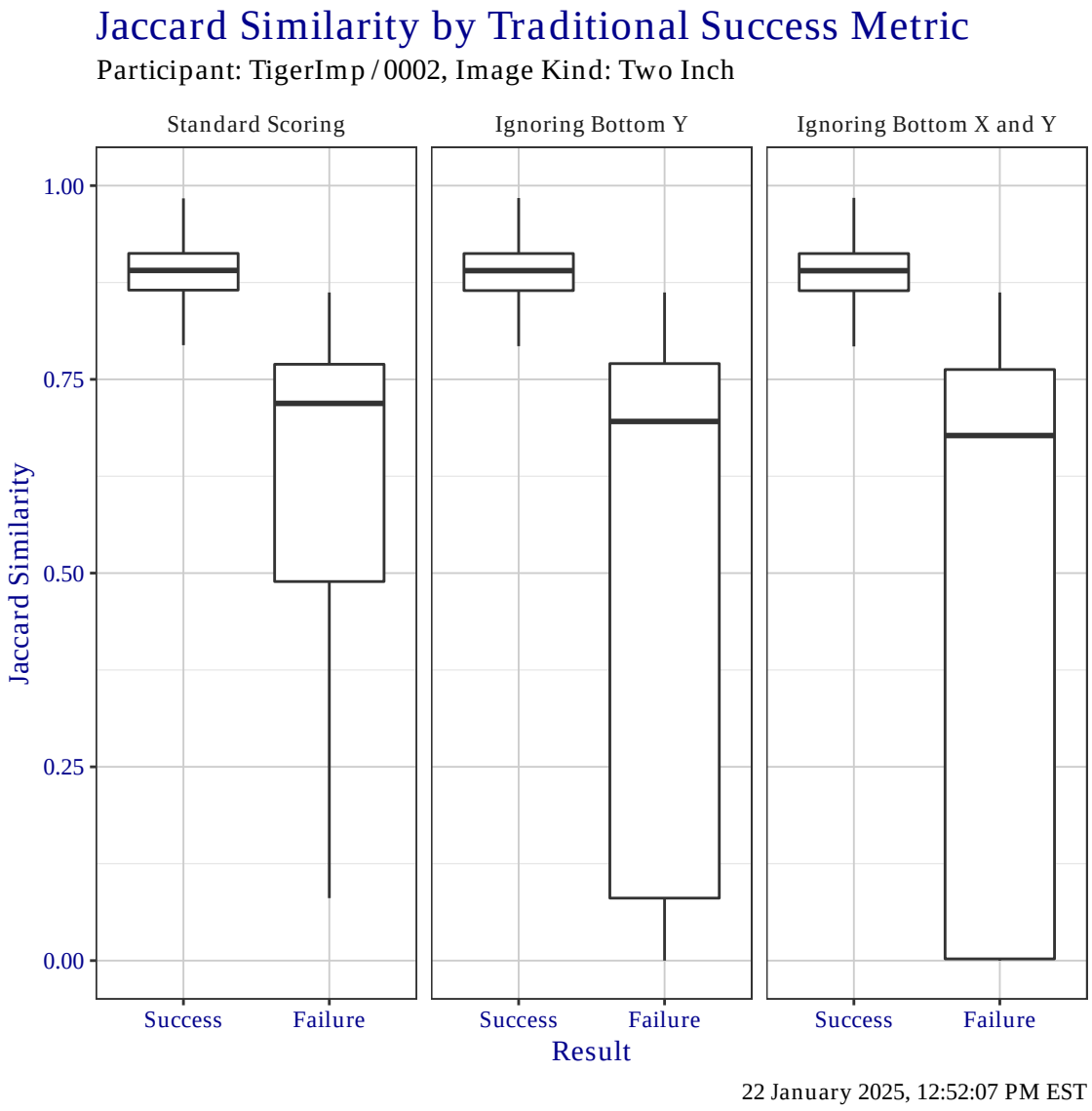

Figure 23: Boxplot of Jaccard similarity indices as compared to the traditional success metrics. Outliers have been removed for clarity.

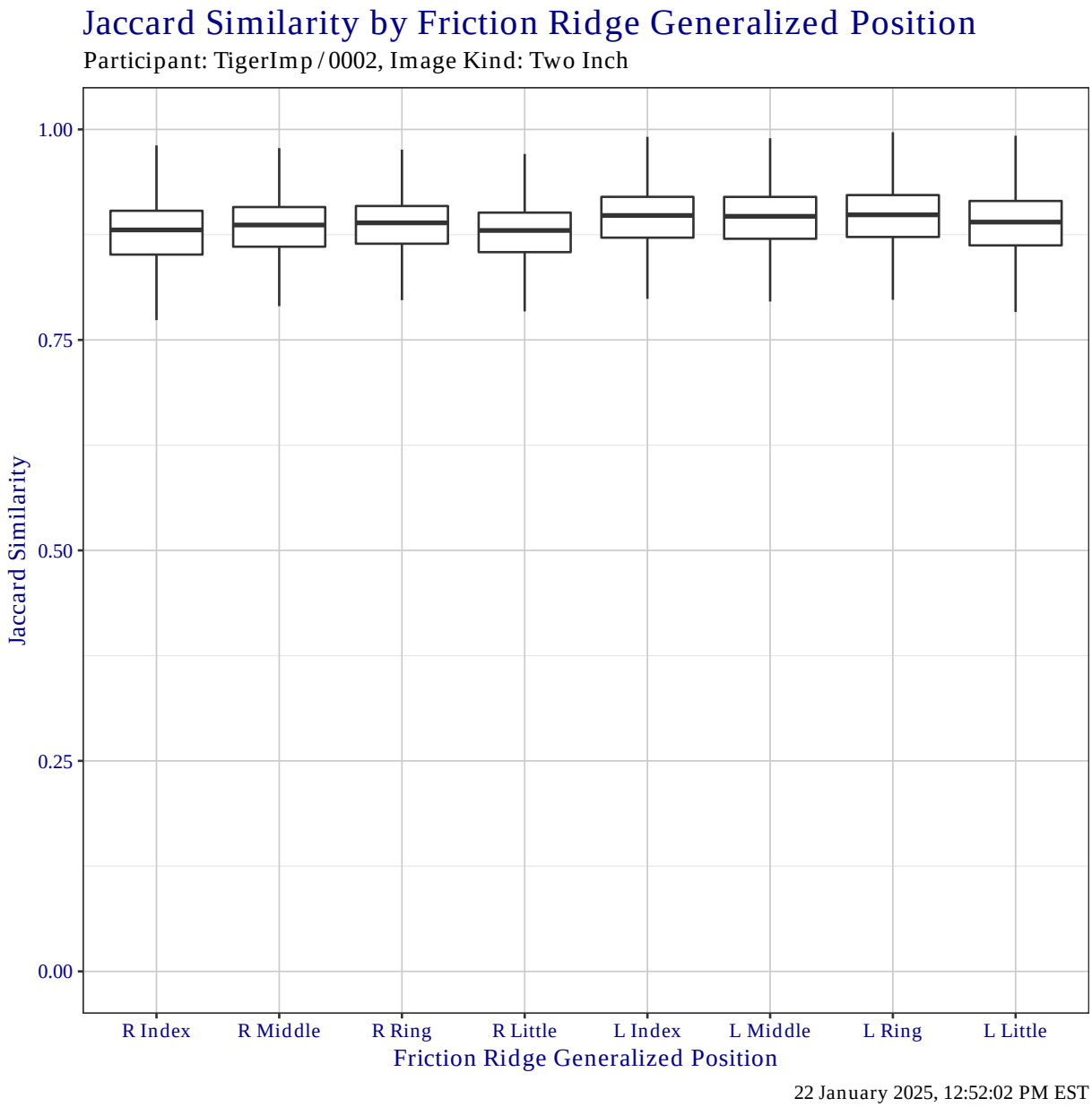

Figure 24: Boxplot of Jaccard similarity indices for each friction ridge generalized position. Outliers have been removed for clarity.

Table 47: For each subject, the percentage that at least *Number of Fingers* fingers were segmented with a Jaccard index in the indicated range.

Number of Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
1	100.0	100.0	99.9	99.8	90.1	19.3	1.0
2	99.9	99.9	99.9	99.5	76.7	5.1	0.0
3	99.8	99.8	99.7	98.9	59.8	1.2	0.0
4	99.6	99.5	99.1	97.6	40.9	0.2	0.0
5	95.6	95.6	95.4	94.6	22.6	0.0	0
6	95.4	95.4	95.2	93.3	10.3	0	0
7	95.1	95.0	94.5	88.9	3.2	0	0
8	92.8	92.2	89.5	70.7	0.5	0	0

Table 48: For all subjects, percentage that a particular friction ridge generalized position was segmented with a Jaccard index in the indicated range.

Finger	0-0.5	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.9-1.0
Right						
Index	0.8	0.2	0.8	6.1	63.2	28.9
Middle	0.6	0.1	0.3	3.7	61.4	33.9
Ring	0.3	0.1	0.4	3.5	59.5	36.2
Little	0.6	0.1	0.4	4.4	68.0	26.5
Left						
Index	0.7	0.2	0.5	2.8	48.4	47.4
Middle	0.9	0.2	0.4	2.9	49.3	46.3
Ring	0.6	0.0	0.6	3.1	47.3	48.4
Little	0.9	0.1	0.3	3.5	55.5	39.7

Table 49: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of all eight fingers of a TwoInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	99.8	99.8	99.8	99.4	67.6	3.9	0.1
At Least Two	99.8	99.8	99.7	99.0	38.8	0.2	0.0
At Least Three	99.6	99.6	99.4	96.7	15.7	0.0	0.0
All Four	98.5	98.1	96.4	82.6	3.4	0.0	0.0
Left							
Any	99.8	99.8	99.7	99.4	79.5	15.2	0.8
At Least Two	99.7	99.6	99.5	98.9	57.1	3.9	0.0
At Least Three	99.5	99.4	99.2	97.2	33.1	0.8	0.0
All Four	98.0	97.7	96.2	86.8	12.2	0.1	0.0

Table 50: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index and middle fingers of a TwoInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Either Index or Middle	99.7	99.7	99.6	98.7	49.5	2.1	0.1
Both Index and Middle	98.9	98.6	97.5	88.7	13.3	0.1	0.0
Left							
Either Index or Middle	99.7	99.6	99.5	98.9	66.1	8.6	0.4
Both Index and Middle	98.7	98.4	97.6	92.6	27.6	0.9	0.0

Table 51: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index, middle, and ring fingers of a TwoInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	99.8	99.8	99.7	99.3	62.0	3.3	0.1
At Least Two	99.6	99.6	99.5	97.7	29.5	0.2	0.0
All Three	98.8	98.5	97.1	86.2	7.6	0.0	0.0
Left							
Any	99.7	99.7	99.6	99.2	75.2	12.7	0.7
At Least Two	99.6	99.5	99.3	98.0	47.5	2.7	0.0
All Three	98.6	98.3	97.0	89.9	19.4	0.3	0.0

B Identification Flats ("ThreeInch" Data)

B.1 Bootstrap Confidence for Segmentation Statistics

This section shows the same detailed results of segmentation of ThreeInch data from Section 3.3, but with an added bootstrap confidence interval. For each observation, a bootstrap routine with 1 000 replicates was run, and a 95 % confidence interval extracted. The lower and upper confidence from that confidence interval are printed in each column within square brackets.

In Table 52, results are shown of how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 53 shows success for specific finger positions over the entire test corpus. Similarly, Table 54 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers in each slap image. Table 55 shows success for combinations of all fingers, Table 57 for the all except the little finger, and Table 56 for just the index and middle fingers.

Table 52: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.8 [99.7, 99.8]	99.8 [99.7, 99.8]	99.8 [99.7, 99.8]
2	99.2 [99.1, 99.3]	99.2 [99.1, 99.3]	99.2 [99.1, 99.3]
3	98.4 [98.3, 98.6]	98.4 [98.3, 98.6]	98.5 [98.3, 98.6]
4	98.1 [97.9, 98.2]	98.1 [97.9, 98.2]	98.1 [97.9, 98.3]
5	95.9 [95.6, 96.1]	95.9 [95.6, 96.1]	95.9 [95.6, 96.1]
6	95.8 [95.6, 96.1]	95.8 [95.6, 96.1]	95.9 [95.6, 96.1]
7	95.8 [95.5, 96.0]	95.8 [95.5, 96.0]	95.8 [95.5, 96.0]
8	95.4 [95.1, 95.6]	95.4 [95.1, 95.7]	95.5 [95.2, 95.8]
9	92.9 [92.6, 93.2]	93.0 [92.7, 93.3]	93.7 [93.4, 94.0]
10	81.9 [81.3, 82.3]	82.3 [81.8, 82.7]	84.9 [84.4, 85.3]

Table 53: For all subjects, Percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Thumb	95.3 [95.0, 95.5]	95.3 [95.1, 95.6]	96.2 [96.0, 96.4]
Index	99.2 [99.1, 99.3]	99.2 [99.1, 99.3]	99.3 [99.2, 99.4]
Middle	98.9 [98.7, 99.0]	98.9 [98.7, 99.0]	99.3 [99.2, 99.4]
Ring	97.9 [97.7, 98.1]	98.0 [97.9, 98.2]	98.4 [98.3, 98.6]
Little	98.0 [97.9, 98.2]	98.1 [97.9, 98.2]	98.2 [98.0, 98.3]
Left			
Thumb	95.9 [95.7, 96.2]	96.0 [95.8, 96.3]	96.9 [96.7, 97.1]
Index	98.3 [98.1, 98.4]	98.3 [98.1, 98.5]	98.4 [98.3, 98.5]
Middle	98.7 [98.5, 98.8]	98.7 [98.6, 98.9]	99.1 [99.0, 99.3]
Ring	98.8 [98.7, 99.0]	99.0 [98.8, 99.1]	99.3 [99.2, 99.4]
Little	98.4 [98.2, 98.6]	98.4 [98.3, 98.6]	98.5 [98.4, 98.7]

Table 54: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Thumb			
Either	98.7 [98.6, 98.8]	98.7 [98.6, 98.9]	99.0 [98.8, 99.1]
Both	92.5 [92.2, 92.9]	92.7 [92.4, 93.0]	94.2 [93.9, 94.5]
Index			
Either	99.8 [99.7, 99.9]	99.8 [99.7, 99.8]	99.8 [99.8, 99.9]
Both	95.1 [94.8, 95.3]	95.1 [94.8, 95.3]	95.3 [95.0, 95.5]
Middle			
Either	99.7 [99.7, 99.8]	99.7 [99.7, 99.8]	99.8 [99.7, 99.8]
Both	95.2 [94.9, 95.4]	95.2 [95.0, 95.5]	95.9 [95.7, 96.2]
Ring			
Either	99.7 [99.7, 99.8]	99.7 [99.7, 99.8]	99.8 [99.7, 99.8]
Both	94.3 [94.0, 94.6]	94.5 [94.3, 94.8]	95.2 [94.9, 95.5]
Little			
Either	99.6 [99.5, 99.7]	99.6 [99.5, 99.7]	99.6 [99.6, 99.7]
Both	94.2 [93.9, 94.5]	94.2 [93.9, 94.5]	94.4 [94.1, 94.7]

Table 55: Percentage of segmentation success by hand for combinations of all ten fingers of a ThreeInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.4 [99.4, 99.5]	99.4 [99.4, 99.5]	99.4 [99.5, 99.6]
At Least Two	98.4 [98.3, 98.6]	98.4 [98.3, 98.6]	98.5 [98.4, 98.6]
At Least Three	98.3 [98.2, 98.4]	98.3 [98.2, 98.4]	98.4 [98.2, 98.4]
At Least Four	97.3 [97.1, 97.4]	97.3 [97.2, 97.5]	97.5 [97.4, 97.7]
All Five	86.9 [86.9, 87.4]	87.1 [87.1, 87.7]	88.7 [88.6, 89.2]
Left			
Any	99.6 [99.4, 99.5]	99.6 [99.4, 99.5]	99.6 [99.5, 99.6]
At Least Two	98.5 [98.3, 98.6]	98.5 [98.3, 98.6]	98.5 [98.4, 98.6]
At Least Three	98.3 [98.2, 98.4]	98.3 [98.2, 98.4]	98.3 [98.2, 98.4]
At Least Four	97.3 [97.1, 97.4]	97.3 [97.2, 97.5]	97.5 [97.4, 97.7]
All Five	87.4 [86.9, 87.4]	87.7 [87.1, 87.7]	89.2 [88.6, 89.2]

Table 56: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	99.8 [99.8, 99.9]	99.8 [99.8, 99.9]	99.9 [99.8, 99.9]
Both Index and Middle	98.3 [97.6, 97.8]	98.3 [97.6, 97.9]	98.8 [98.1, 98.3]
Left			
Either Index or Middle	99.8 [99.8, 99.9]	99.8 [99.8, 99.9]	99.8 [99.8, 99.9]
Both Index and Middle	97.2 [97.6, 97.8]	97.2 [97.6, 97.9]	97.7 [98.1, 98.3]

Table 57: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	99.9 [99.9, 99.9]	99.9 [99.9, 99.9]	99.9 [99.9, 99.9]
At Least Two	99.6 [99.5, 99.6]	99.6 [99.5, 99.7]	99.7 [99.6, 99.7]
All Three	96.5 [96.2, 96.6]	96.6 [96.4, 96.7]	97.4 [97.2, 97.5]
Left			
Any	99.9 [99.9, 99.9]	99.9 [99.9, 99.9]	99.9 [99.9, 99.9]
At Least Two	99.6 [99.5, 99.6]	99.6 [99.5, 99.7]	99.7 [99.6, 99.7]
All Three	96.3 [96.2, 96.6]	96.5 [96.4, 96.7]	97.2 [97.2, 97.5]

B.2 Jaccard Index

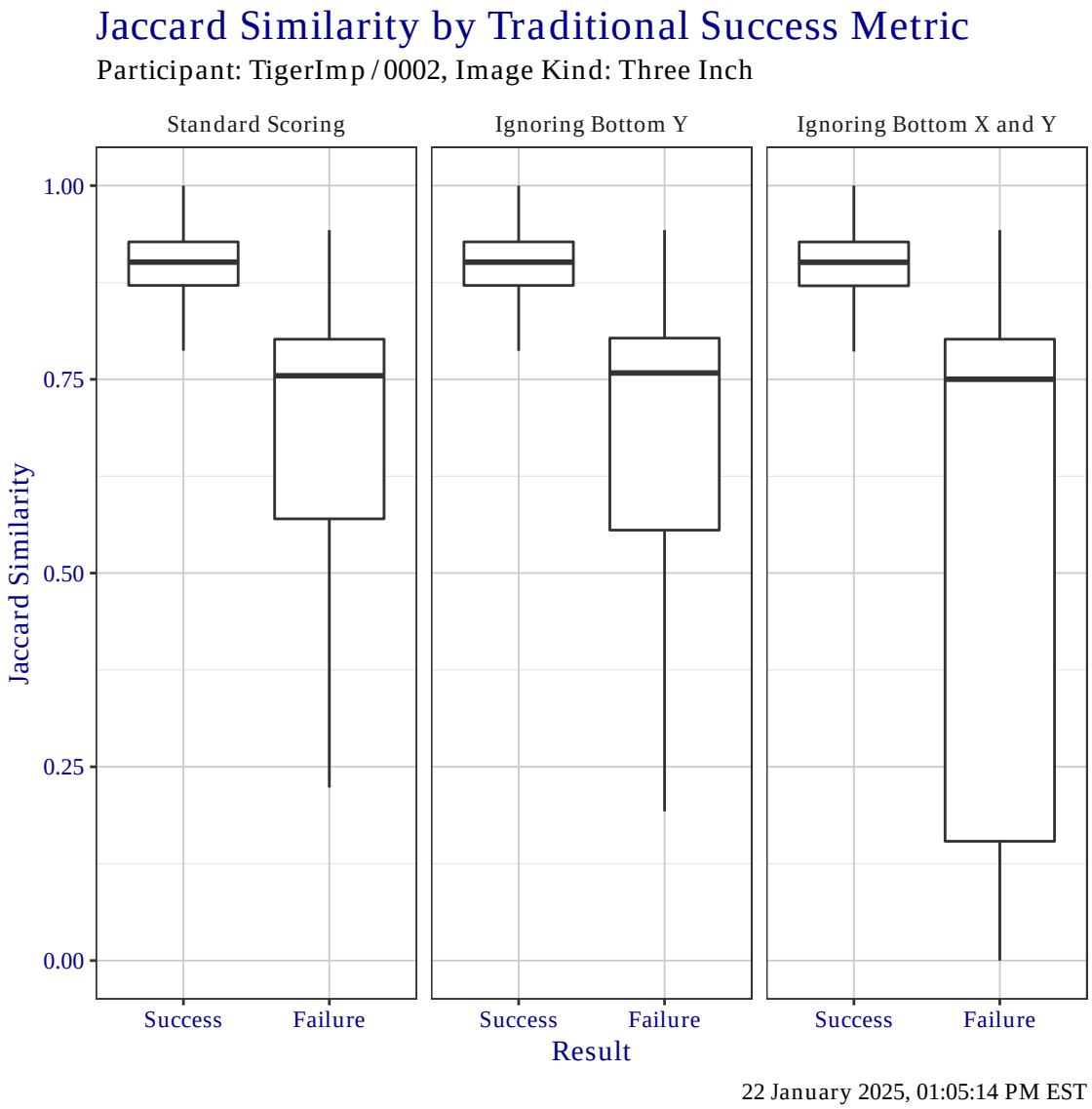

Figure 25: Boxplot of Jaccard similarity indices as compared to the traditional success metrics. Outliers have been removed for clarity.

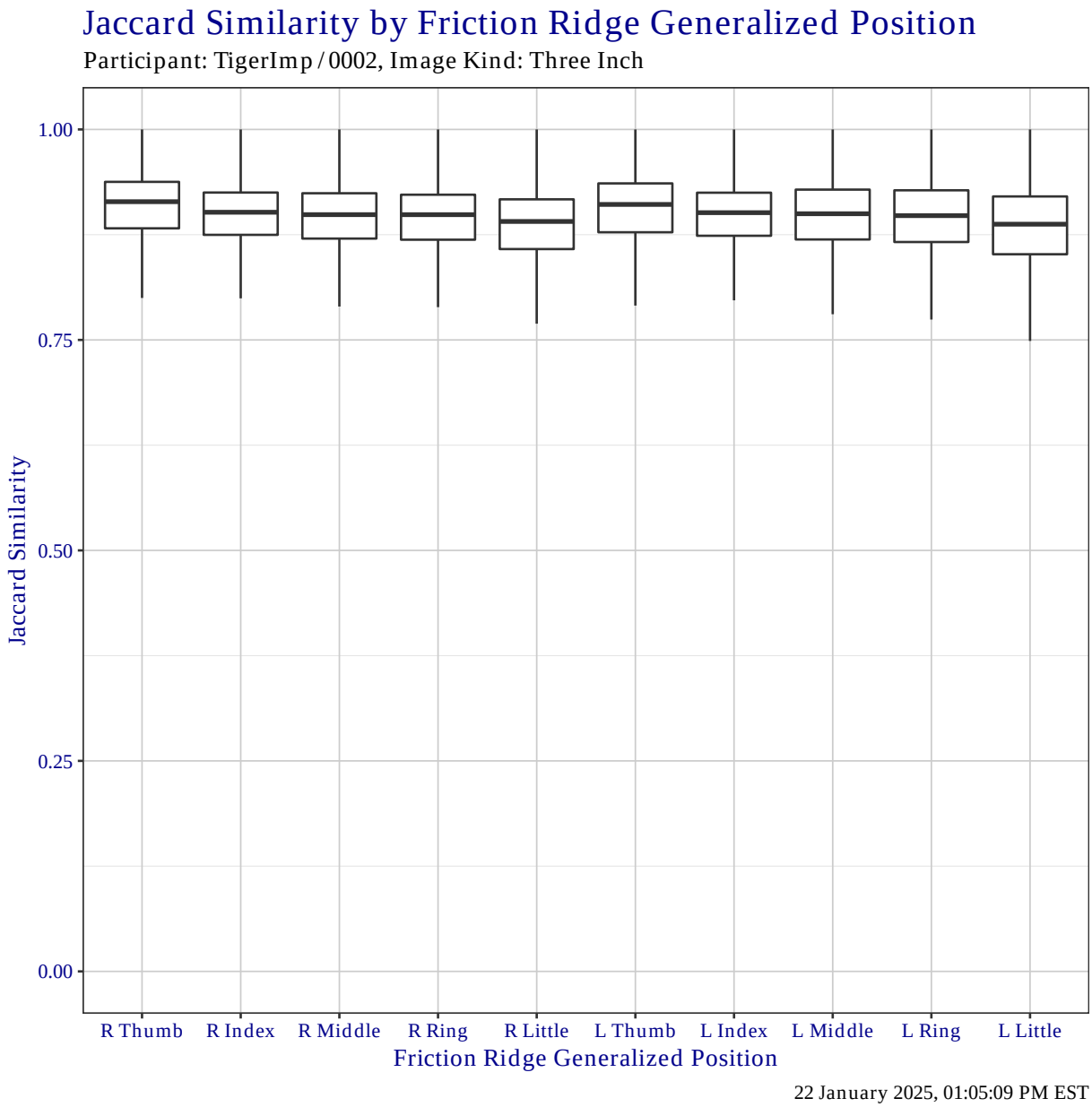

Figure 26: Boxplot of Jaccard similarity indices for each friction ridge generalized position. Outliers have been removed for clarity.

Table 58: For each subject, the percentage that at least *Number of Fingers* fingers were segmented with a Jaccard index in the indicated range.

Number of Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
1	99.9	99.9	99.9	99.7	96.7	51.7	4.1
2	99.8	99.8	99.7	99.2	91.9	22.9	0.2
3	98.5	98.5	98.5	98.2	83.3	8.4	0.0
4	98.3	98.3	98.2	97.9	71.5	2.5	0.0
5	95.9	95.9	95.9	95.7	56.2	0.6	0.0
6	95.9	95.9	95.9	95.5	41.1	0.1	0
7	95.8	95.8	95.8	94.6	26.6	0.0	0
8	95.8	95.7	95.6	92.7	14.8	0	0
9	95.2	95.1	94.8	87.4	6.2	0	0
10	93.1	92.8	90.9	71.4	1.7	0	0

Table 59: For all subjects, percentage that a particular friction ridge generalized position was segmented with a Jaccard index in the indicated range.

Finger	0-0.5	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.9-1.0
Right						
Thumb	1.5	0.1	0.3	2.6	32.7	62.8
Index	0.2	0.0	0.2	2.4	45.5	51.7
Middle	0.2	0.0	0.2	3.1	47.8	48.7
Ring	0.2	0.0	0.4	3.6	47.0	48.8
Little	0.5	0.0	0.3	5.2	53.1	40.9
Left						
Thumb	1.5	0.1	0.2	3.0	35.4	59.8
Index	0.1	0.0	0.1	2.7	45.9	51.2
Middle	0.1	0.0	0.2	3.2	46.6	49.9
Ring	0.2	0.0	0.4	2.9	48.7	47.8
Little	0.5	0.1	0.4	5.6	53.1	40.3

Table 60: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of all ten fingers of a ThreeInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	99.9	99.9	99.8	99.5	89.7	29.2	1.7
At Least Two	98.5	98.5	98.5	98.0	70.4	7.6	0.0
At Least Three	98.5	98.5	98.4	97.2	49.1	2.0	0.0
At Least Four	98.2	98.2	97.9	94.3	28.7	0.3	0.0
All Five	93.3	93.1	92.1	81.2	10.1	0.0	0.0
Left							
Any	99.9	99.9	99.8	99.6	89.3	34.0	2.5
At Least Two	98.5	98.5	98.5	98.2	68.5	10.3	0.1
At Least Three	98.4	98.4	98.4	97.4	48.4	2.8	0.0
At Least Four	98.2	98.2	98.0	94.4	28.5	0.4	0.0
All Five	93.3	93.2	92.1	80.1	9.4	0.0	0.0

Table 61: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index and middle fingers of a ThreeInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Either Index or Middle	99.9	99.9	99.9	99.0	67.4	13.1	0.7
Both Index and Middle	99.7	99.7	99.3	94.8	33.0	2.1	0.0
Left							
Either Index or Middle	99.9	99.9	99.9	99.3	67.1	15.7	1.0
Both Index and Middle	99.8	99.8	99.5	94.3	34.0	2.6	0.0

Table 62: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index, middle, and ring fingers of a ThreeInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	99.9	99.9	99.9	99.4	76.3	16.5	0.9
At Least Two	99.9	99.9	99.8	98.1	49.6	3.9	0.0
All Three	99.7	99.6	98.9	92.1	23.3	0.6	0.0
Left							
Any	100.0	99.9	99.9	99.7	74.7	21.5	1.5
At Least Two	99.9	99.9	99.8	98.4	49.3	6.0	0.1
All Three	99.7	99.6	99.0	92.0	24.9	0.9	0

C Upper Palm ("FiveInch" Data)

C.1 Bootstrap Confidence for Segmentation Statistics

This section shows the same detailed results of segmentation of FiveInch data from Section 4.3, but with an added bootstrap confidence interval. For each observation, a bootstrap routine with 1 000 replicates was run, and a 95 % confidence interval extracted. The lower and upper confidence from that confidence interval are printed in each column within square brackets.

In Table 63, results are shown of how successful `TigerImp+0002` segmented fingers for each subject in the test corpus. Table 64 shows success for specific finger positions over the entire test corpus. Similarly, Table 65 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers in each slap image. Table 66 shows success for combinations of all fingers, Table 68 for the all except the little finger, and Table 67 for just the index and middle fingers.

Table 63: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.3 [98.7, 99.9]	99.3 [98.7, 99.9]	99.3 [98.7, 99.9]
2	99.2 [98.6, 99.7]	99.2 [98.6, 99.7]	99.2 [98.6, 99.7]
3	98.0 [97.0, 98.9]	98.2 [97.1, 99.1]	98.2 [97.1, 99.1]
4	95.9 [94.5, 97.2]	96.0 [94.7, 97.4]	96.3 [95.0, 97.5]
5	91.4 [89.2, 93.5]	91.7 [89.6, 93.5]	91.8 [90.0, 93.8]
6	83.8 [80.8, 86.3]	84.1 [81.0, 86.6]	84.5 [82.1, 87.1]
7	71.7 [68.5, 74.8]	72.2 [68.8, 75.5]	74.3 [71.4, 77.5]
8	47.0 [43.6, 50.5]	47.4 [43.6, 50.9]	51.3 [47.8, 54.7]

Table 64: For all subjects, Percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	88.7 [86.6, 90.8]	88.8 [86.6, 91.0]	88.8 [86.6, 91.0]
Middle	89.1 [86.8, 91.4]	89.5 [87.1, 91.5]	91.4 [89.5, 93.4]
Ring	91.0 [89.0, 93.0]	91.1 [89.1, 93.0]	91.5 [89.4, 93.4]
Little	83.9 [81.1, 86.3]	83.9 [81.3, 86.7]	85.1 [82.5, 87.6]
Left			
Index	84.6 [81.8, 87.3]	85.1 [82.6, 87.7]	85.4 [82.8, 87.9]
Middle	88.3 [85.8, 90.6]	88.5 [86.2, 90.6]	88.9 [86.5, 91.0]
Ring	89.4 [87.3, 91.6]	89.7 [87.1, 91.8]	89.9 [87.5, 92.0]
Little	76.9 [73.9, 79.8]	77.1 [74.0, 80.0]	79.4 [76.4, 82.4]

Table 65: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	95.9 [94.5, 97.2]	96.0 [94.6, 97.4]	96.0 [94.6, 97.4]
Both	76.0 [73.0, 79.2]	76.5 [73.5, 79.6]	76.8 [73.8, 80.0]
Middle			
Either	96.7 [95.4, 97.9]	96.8 [95.7, 98.0]	97.4 [96.0, 98.4]
Both	79.3 [76.3, 82.1]	79.7 [76.7, 82.6]	81.4 [78.8, 84.2]
Ring			
Either	97.5 [96.3, 98.6]	97.6 [96.6, 98.7]	97.6 [96.4, 98.7]
Both	81.4 [78.5, 84.1]	81.7 [79.1, 84.5]	82.3 [79.6, 85.0]
Little			
Either	94.7 [93.1, 96.2]	94.7 [93.1, 96.3]	95.4 [93.8, 96.8]
Both	64.8 [61.1, 68.2]	65.0 [61.3, 68.2]	67.9 [64.6, 71.1]

Table 66: Percentage of segmentation success by hand for combinations of all eight fingers of a FiveInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.3 [97.1, 98.5]	98.3 [97.1, 98.5]	98.3 [97.1, 98.5]
At Least Two	95.9 [93.7, 95.9]	95.9 [93.7, 95.9]	96.0 [93.8, 96.1]
At Least Three	88.8 [85.3, 88.7]	89.1 [85.4, 88.9]	89.4 [85.9, 89.2]
All Four	69.7 [63.8, 68.9]	70.1 [64.4, 69.3]	73.1 [67.5, 72.0]
Left			
Any	97.3 [97.1, 98.5]	97.5 [97.1, 98.5]	97.5 [97.1, 98.5]
At Least Two	93.8 [93.7, 95.9]	93.8 [93.7, 95.9]	94.0 [93.8, 96.1]
At Least Three	85.3 [85.3, 88.7]	85.4 [85.4, 88.9]	85.8 [85.9, 89.2]
All Four	62.9 [63.8, 68.9]	63.7 [64.4, 69.3]	66.3 [67.5, 72.0]

Table 67: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	95.6 [93.6, 95.9]	95.7 [93.7, 95.8]	96.0 [93.8, 96.0]
Both Index and Middle	82.2 [78.8, 82.7]	82.6 [79.3, 83.0]	84.2 [80.2, 84.2]
Left			
Either Index or Middle	93.8 [93.6, 95.9]	93.8 [93.7, 95.8]	93.9 [93.8, 96.0]
Both Index and Middle	79.2 [78.8, 82.7]	79.8 [79.3, 83.0]	80.4 [80.2, 84.2]

Table 68: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	97.5 [96.1, 97.9]	97.5 [96.2, 97.9]	97.5 [96.2, 97.9]
At Least Two	93.8 [90.7, 93.5]	93.9 [90.8, 93.6]	94.1 [91.2, 93.8]
All Three	77.5 [74.1, 78.4]	78.1 [74.6, 79.1]	80.1 [76.1, 80.4]
Left			
Any	96.6 [96.1, 97.9]	96.7 [96.2, 97.9]	96.7 [96.2, 97.9]
At Least Two	90.7 [90.7, 93.5]	90.7 [90.8, 93.6]	90.8 [91.2, 93.8]
All Three	75.1 [74.1, 78.4]	75.9 [74.6, 79.1]	76.7 [76.1, 80.4]

C.2 Jaccard Index

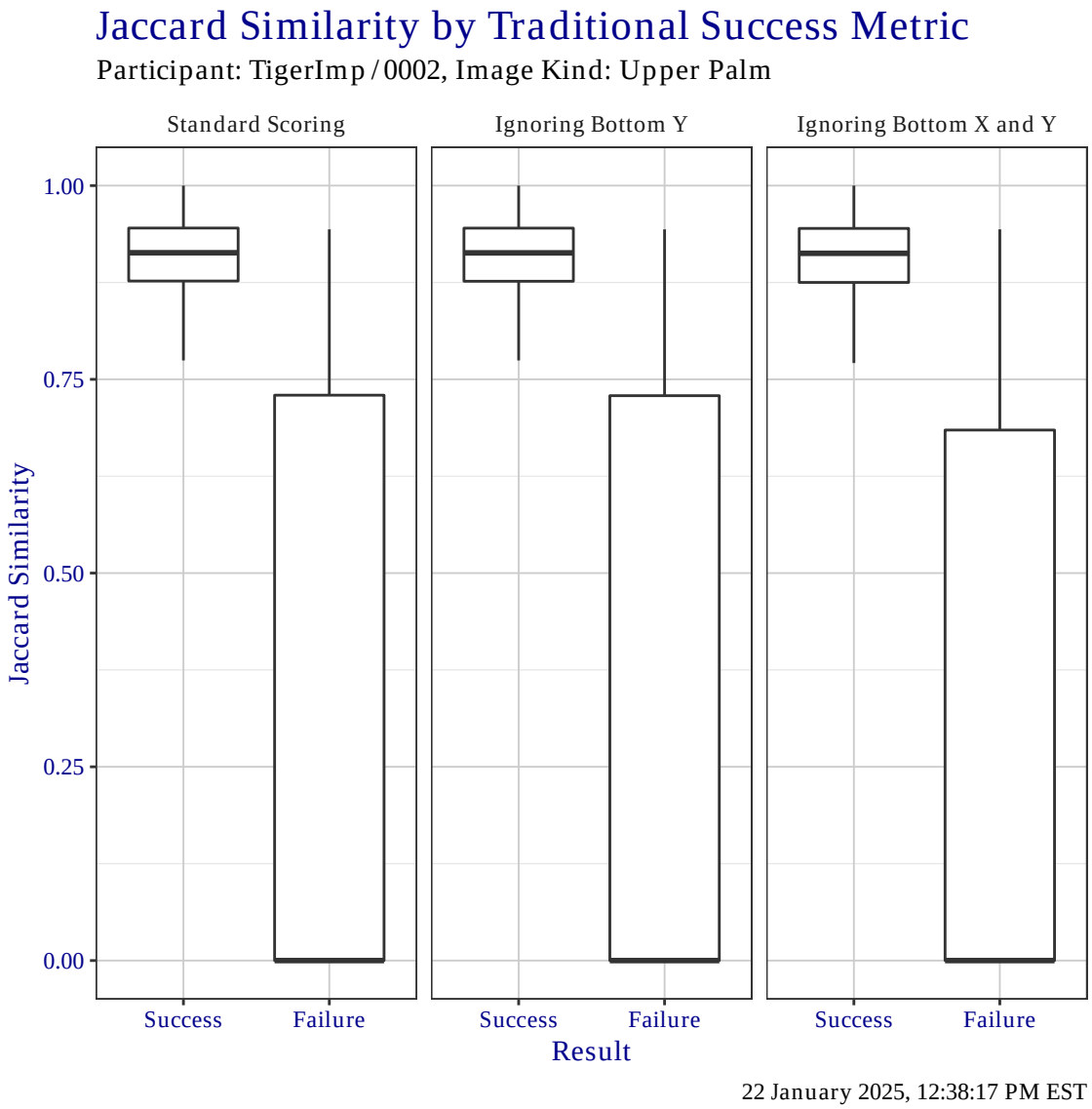

Figure 27: Boxplot of Jaccard similarity indices as compared to the traditional success metrics. Outliers have been removed for clarity.

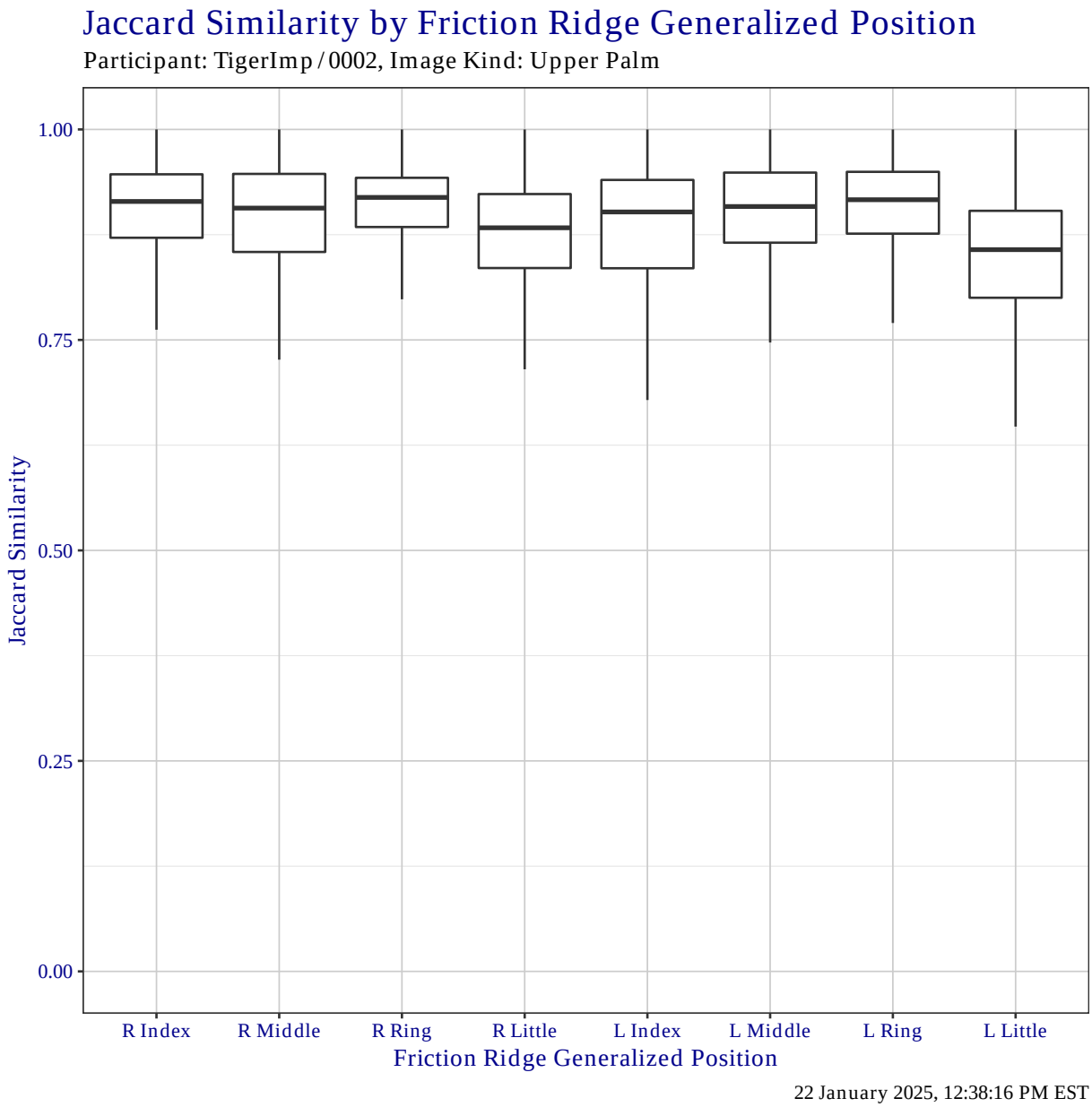

Figure 28: Boxplot of Jaccard similarity indices for each friction ridge generalized position. Outliers have been removed for clarity.

Table 69: For each subject, the percentage that at least *Number of Fingers* fingers were segmented with a Jaccard index in the indicated range.

Number of Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
1	99.5	99.5	99.5	99.3	97.4	60.6	30.0
2	99.2	99.2	99.2	98.9	91.4	32.9	22.1
3	98.3	98.3	98.3	97.5	80.5	20.7	16.9
4	97.2	97.2	97.2	95.5	62.8	13.3	12.8
5	93.3	93.3	93.0	90.0	39.7	10.1	9.7
6	88.1	88.0	86.2	80.8	24.5	7.9	7.8
7	79.3	78.7	77.6	66.5	10.5	5.7	5.7
8	68.9	67.6	63.6	44.1	5.3	4.0	4.0

Table 70: For all subjects, percentage that a particular friction ridge generalized position was segmented with a Jaccard index in the indicated range.

Finger	0-0.5	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.9-1.0
Right						
Index	9.2	0.2	0.4	2.8	27.0	60.4
Middle	6.8	0.1	0.5	5.6	32.7	54.3
Ring	7.8	0.3	0.5	1.5	25.4	64.5
Little	9.2	0.3	0.7	6.2	43.7	39.9
Left						
Index	10.1	0.7	1.7	6.4	30.2	50.9
Middle	9.5	0.1	0.7	4.4	29.2	56.1
Ring	8.1	0	0.8	2.4	26.0	62.7
Little	9.7	0.4	1.8	13.0	48.4	26.7

Table 71: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of all ten fingers of a FiveInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	98.3	98.3	98.3	98.3	92.7	43.8	23.5
At Least Two	96.0	96.0	96.0	94.7	70.7	18.4	15.3
At Least Three	90.7	90.6	90.6	87.0	40.2	11.2	11.0
All Four	82.0	81.2	79.1	68.0	15.4	7.3	7.3
Left							
Any	98.0	98.0	97.9	97.3	87.4	43.1	23.1
At Least Two	95.6	95.5	95.2	93.1	65.6	17.8	14.9
At Least Three	88.9	88.7	87.3	81.4	32.4	9.5	9.3
All Four	80.1	79.2	76.0	58.4	11.0	5.4	5.4

Table 72: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index and middle fingers of a FiveInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Either Index or Middle	96.5	96.5	96.5	95.1	78.5	35.6	21.8
Both Index and Middle	87.5	87.1	86.2	79.3	36.2	12.1	11.2
Left							
Either Index or Middle	94.7	94.7	94.3	92.7	74.8	31.8	21.1
Both Index and Middle	85.7	84.9	82.9	73.7	32.2	10.9	10.3

Table 73: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index, middle, and ring fingers of a FiveInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	97.5	97.5	97.5	97.2	89.4	40.7	23.0
At Least Two	94.7	94.7	94.7	92.4	62.4	17.6	14.8
All Three	84.0	83.4	81.9	74.6	27.4	10.0	9.8
Left							
Any	97.3	97.3	97.2	96.6	85.7	41.9	22.5
At Least Two	92.6	92.6	91.8	89.1	60.2	17.0	14.2
All Three	82.4	81.6	79.3	69.5	23.9	8.6	8.6

D Full Palm ("EightInch" Data)

D.1 Bootstrap Confidence for Segmentation Statistics

NOTE: *The following segmentation statistics are based on a limited subset (approximately 15%) of the anticipated Full Palm dataset. This analysis will be updated as soon as NIST can obtain the remainder of the dataset.*

This section shows the same detailed results of segmentation of EightInch data from Section 5.3, but with an added bootstrap confidence interval. For each observation, a bootstrap routine with 1 000 replicates was run, and a 95 % confidence interval extracted. The lower and upper confidence from that confidence interval are printed in each column within square brackets.

In Table 74, results are shown of how successful TigerImp+0002 segmented fingers for each subject in the test corpus. Table 75 shows success for specific finger positions over the entire test corpus. Similarly, Table 76 shows success for segmenting the same finger position from both hands.

The remainder of the tables show success per subject when considering combinations of subsets of the fingers in each slap image. Table 77 shows success for combinations of all fingers, Table 79 for the all except the little finger, and Table 78 for just the index and middle fingers.

Table 74: For each subject, the percentage that at least *Number of Fingers* fingers were correctly segmented, regardless of hand, for a maximum of eight correctly-segmented fingers. In *Standard Scoring*, scoring rules are followed exactly. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Number of Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
1	99.9 [99.7, 100.0]	99.9 [99.5, 100.0]	99.9 [99.7, 100.0]
2	99.9 [99.7, 100.0]	99.9 [99.7, 100.0]	99.9 [99.7, 100.0]
3	99.9 [99.7, 100.0]	99.9 [99.7, 100.0]	99.9 [99.7, 100.0]
4	99.0 [98.3, 99.7]	99.0 [98.3, 99.5]	99.2 [98.6, 99.8]
5	98.0 [97.0, 98.9]	98.0 [97.1, 99.0]	98.0 [97.1, 98.9]
6	96.7 [95.5, 97.8]	96.9 [95.6, 98.0]	97.1 [96.0, 98.2]
7	94.5 [92.9, 95.7]	94.6 [93.0, 96.1]	95.3 [93.8, 96.7]
8	80.8 [78.2, 83.3]	82.1 [79.4, 84.4]	83.0 [80.6, 85.3]

Table 75: For all subjects, Percentage that a particular friction ridge generalized position was correctly segmented. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Finger	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Index	96.7 [95.4, 97.8]	96.8 [95.5, 97.9]	96.9 [95.6, 98.0]
Middle	96.6 [95.3, 97.7]	96.6 [95.4, 97.8]	96.9 [95.6, 97.9]
Ring	96.1 [94.8, 97.2]	96.6 [95.3, 97.8]	96.9 [95.6, 97.9]
Little	94.6 [92.9, 96.0]	94.9 [93.4, 96.3]	95.2 [93.6, 96.4]
Left			
Index	97.4 [96.2, 98.4]	97.4 [96.2, 98.3]	97.5 [96.3, 98.5]
Middle	97.4 [96.1, 98.4]	97.4 [96.3, 98.4]	97.4 [96.2, 98.5]
Ring	96.2 [94.9, 97.4]	96.7 [95.5, 97.8]	97.2 [96.1, 98.3]
Little	93.8 [92.1, 95.5]	94.0 [92.4, 95.6]	94.4 [92.9, 95.9]

Table 76: Percentage that a particular type of fingerprint was correctly segmented on *Either* or *Both* hands. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Index			
Either	99.8 [99.4, 100.0]	99.8 [99.4, 100.0]	99.9 [99.7, 100.0]
Both	94.3 [92.6, 95.7]	94.4 [92.9, 95.7]	94.5 [92.9, 96.0]
Middle			
Either	99.7 [99.2, 100.0]	99.7 [99.2, 100.0]	99.8 [99.4, 100.0]
Both	94.3 [92.6, 95.7]	94.3 [92.5, 95.9]	94.5 [92.9, 95.9]
Ring			
Either	99.4 [98.9, 99.9]	99.5 [99.1, 99.9]	99.7 [99.2, 100.0]
Both	92.9 [91.1, 94.5]	93.7 [92.2, 95.2]	94.5 [92.8, 96.0]
Little			
Either	99.1 [98.4, 99.7]	99.1 [98.4, 99.7]	99.1 [98.4, 99.7]
Both	89.3 [87.1, 91.5]	89.9 [87.9, 92.0]	90.5 [88.4, 92.3]

Table 77: Percentage of segmentation success by hand for combinations of all eight fingers of a EightInch slap. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.9 [98.5, 99.4]	98.9 [98.4, 99.5]	98.9 [98.5, 99.4]
At Least Two	98.7 [98.2, 99.3]	98.7 [98.2, 99.2]	98.7 [98.3, 99.3]
At Least Three	97.6 [97.1, 98.4]	97.7 [97.2, 98.6]	98.0 [97.5, 98.7]
All Four	88.7 [87.3, 90.3]	89.5 [88.0, 90.9]	90.2 [88.9, 91.7]
Left			
Any	99.1 [98.5, 99.4]	99.1 [98.4, 99.5]	99.1 [98.5, 99.4]
At Least Two	98.7 [98.2, 99.3]	98.7 [98.2, 99.2]	98.9 [98.3, 99.3]
At Least Three	97.9 [97.1, 98.4]	98.0 [97.2, 98.6]	98.2 [97.5, 98.7]
All Four	89.0 [87.3, 90.3]	89.5 [88.0, 90.9]	90.3 [88.9, 91.7]

Table 78: Percentage of segmentation success by hand when only considering combinations of index and middle fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Either Index or Middle	98.7 [98.4, 99.4]	98.7 [98.4, 99.4]	98.7 [98.4, 99.4]
Both Index and Middle	94.5 [94.0, 96.0]	94.6 [94.1, 96.1]	95.1 [94.4, 96.4]
Left			
Either Index or Middle	99.1 [98.4, 99.4]	99.1 [98.4, 99.4]	99.1 [98.4, 99.4]
Both Index and Middle	95.6 [94.0, 96.0]	95.6 [94.1, 96.1]	95.7 [94.4, 96.4]

Table 79: Percentage of segmentation success by hand when only considering combinations of index, middle, and ring fingers. In *Ignoring Bottom Y*, the bottom left and bottom right Y coordinates are ignored. *Ignoring Bottom X and Y* only checks the locations of the top left and top right coordinates. Values in square brackets represent a 95 % confidence interval after bootstrapping with 1 000 replicates.

Fingers	Standard Scoring	Ignoring Bottom Y	Ignoring Bottom X and Y
Right			
Any	98.9 [98.4, 99.4]	98.9 [98.5, 99.4]	98.9 [98.4, 99.4]
At Least Two	98.3 [97.7, 98.9]	98.3 [97.8, 98.9]	98.5 [98.0, 99.1]
All Three	92.2 [91.5, 94.0]	92.8 [92.1, 94.4]	93.3 [92.7, 95.0]
Left			
Any	99.1 [98.4, 99.4]	99.1 [98.5, 99.4]	99.1 [98.4, 99.4]
At Least Two	98.5 [97.7, 98.9]	98.5 [97.8, 98.9]	98.6 [98.0, 99.1]
All Three	93.3 [91.5, 94.0]	93.8 [92.1, 94.4]	94.4 [92.7, 95.0]

D.2 Jaccard Index

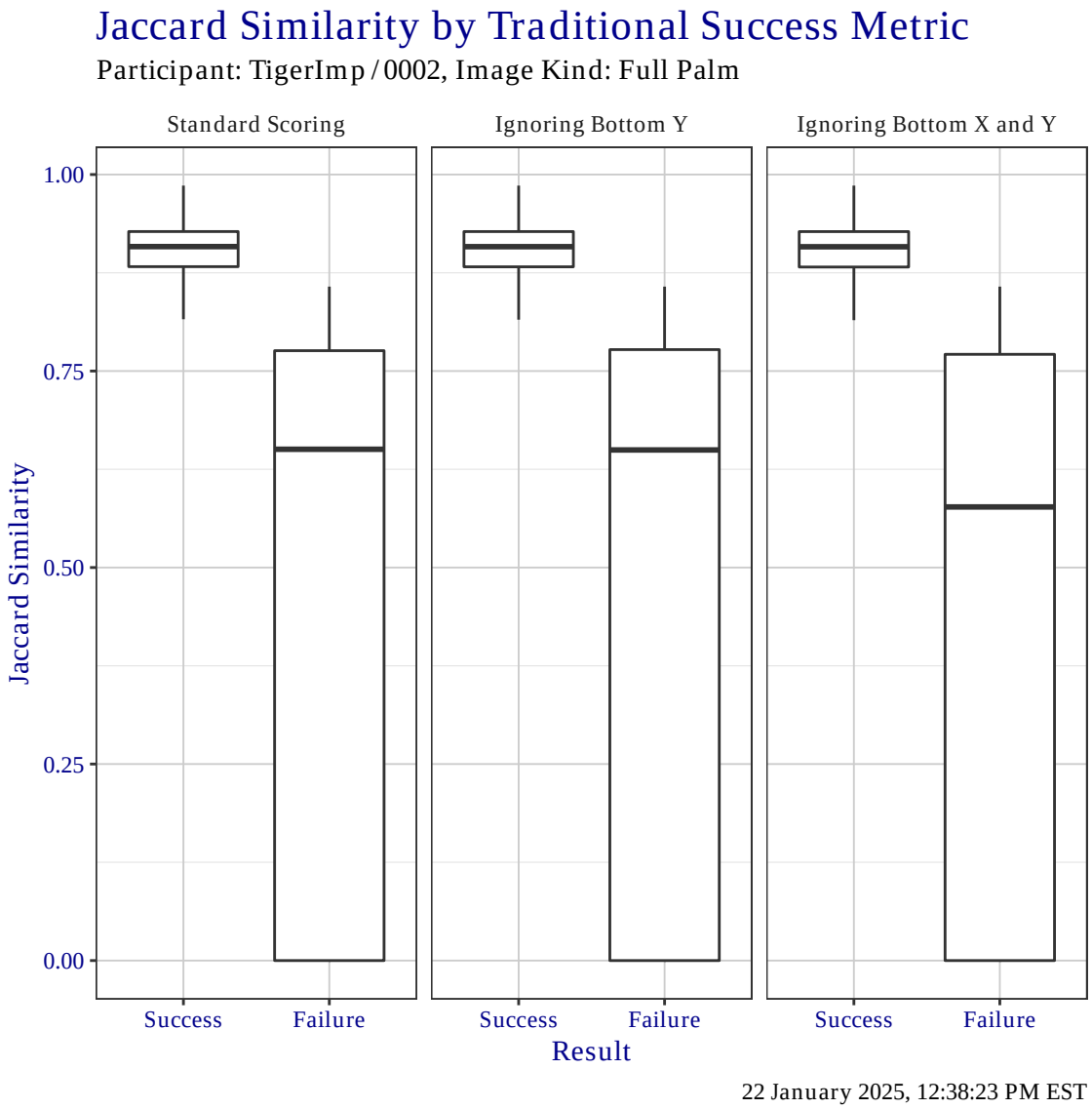

Figure 29: Boxplot of Jaccard similarity indices as compared to the traditional success metrics. Outliers have been removed for clarity.

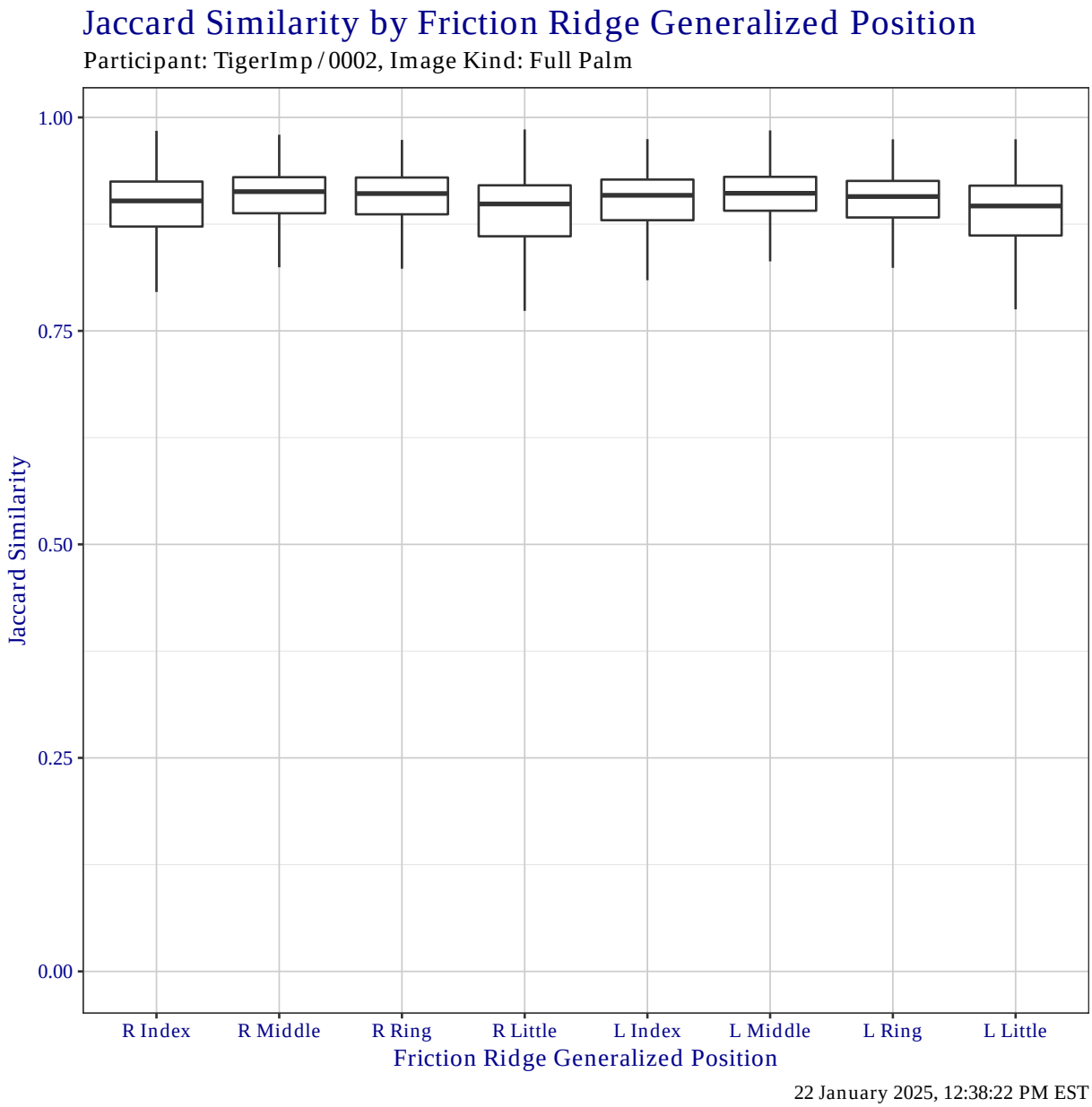

Figure 30: Boxplot of Jaccard similarity indices for each friction ridge generalized position. Outliers have been removed for clarity.

Table 80: For each subject, the percentage that at least *Number of Fingers* fingers were segmented with a Jaccard index in the indicated range.

Number of Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
1	99.9	99.9	99.9	99.9	98.4	23.6	0.3
2	99.9	99.9	99.9	99.8	93.9	6.6	0
3	99.9	99.9	99.9	99.8	85.5	1.6	0
4	99.5	99.4	99.4	98.9	74.3	0.3	0
5	98.2	98.2	98.2	97.6	54.5	0	0
6	97.8	97.8	97.6	95.9	33.3	0	0
7	97.2	97.0	96.2	92.1	15.5	0	0
8	93.8	93.6	90.6	76.6	4.6	0	0

Table 81: For all subjects, percentage that a particular friction ridge generalized position was segmented with a Jaccard index in the indicated range.

Finger	0-0.5	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.9-1.0
Right						
Index	1.4	0	0.5	2.5	43.0	52.6
Middle	1.5	0	0.6	1.8	29.2	66.9
Ring	1.6	0.2	0.8	2.4	32.0	63.0
Little	2.2	0.1	0.5	4.4	44.1	48.7
Left						
Index	1.4	0	0.2	2.4	36.9	59.1
Middle	1.7	0	0.2	2.1	30.5	65.5
Ring	1.5	0	0.8	2.2	36.3	59.2
Little	2.5	0.2	0.5	3.5	48.4	44.9

Table 82: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of all ten fingers of a EightInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	99.0	99.0	99.0	98.9	91.0	15.4	0.2
At Least Two	98.9	98.9	98.9	98.4	74.4	2.9	0.0
At Least Three	98.7	98.7	98.4	96.3	46.7	0.1	0.0
All Four	96.8	96.4	94.5	86.0	19.2	0.0	0.0
Left							
Any	99.1	99.1	99.1	99.1	91.7	11.0	0.1
At Least Two	98.9	98.9	98.9	98.6	74.8	2.4	0.0
At Least Three	98.9	98.9	98.5	96.9	46.3	0.2	0.0
All Four	96.1	95.9	94.5	86.2	15.9	0.0	0.0

Table 83: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index and middle fingers of a EightInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Either Index or Middle	98.9	98.9	98.7	98.4	79.4	10.1	0.1
Both Index and Middle	98.3	98.3	97.4	93.3	40.1	0.5	0
Left							
Either Index or Middle	99.1	99.1	99.0	99.0	81.8	7.7	0.1
Both Index and Middle	97.8	97.8	97.5	93.0	42.8	0.5	0

Table 84: Percentage of segmentation obtaining a Jaccard index in the indicated ranges, by hand, for combinations of index, middle, and ring fingers of a EightInch slap.

Fingers	≥0.5	≥0.6	≥0.7	≥0.8	≥0.9	≥0.95	≥0.98
Right							
Any	98.9	98.9	98.9	98.6	87.4	13.3	0.1
At Least Two	98.7	98.7	98.5	97.6	65.4	2.0	0
All Three	97.9	97.7	96.1	90.5	29.8	0.1	0
Left							
Any	99.1	99.1	99.1	99.1	89.3	10.0	0.1
At Least Two	98.9	98.9	98.7	97.9	65.4	1.3	0
All Three	97.5	97.5	96.3	90.5	29.1	0	0