Slap Fingerprint Segmentation Evaluation 2004

Appendix B Detailed Results

8 March 2005

Contents

B.1 Accuracy by Finger Position

This section provides supplemental information related to the SlapSeg04 Analysis Report, Section 5.1, Accuracy by Finger and Hand.

This series of charts shows the percentage of highly matchable fingerprints, for each finger position (one chart per dataset). These charts exclude database errors (invalid fingerprints and sequence errors), but poor quality fingerprints and partial fingerprints are included.

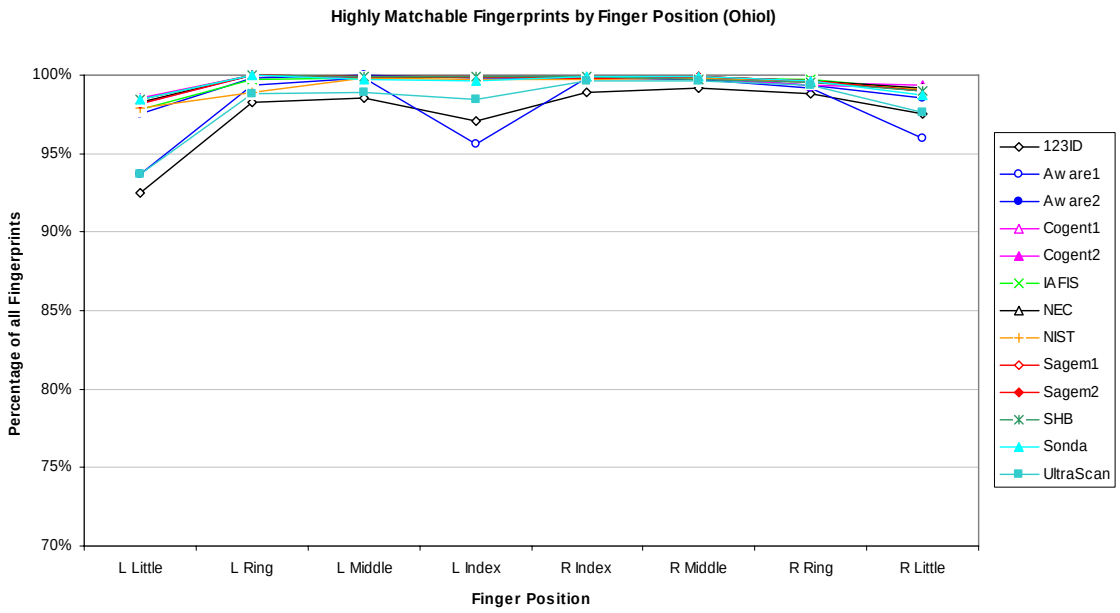

Figure B-1: Percentage of highly matchable fingerprints, for OhioI dataset, by finger position and segmenter

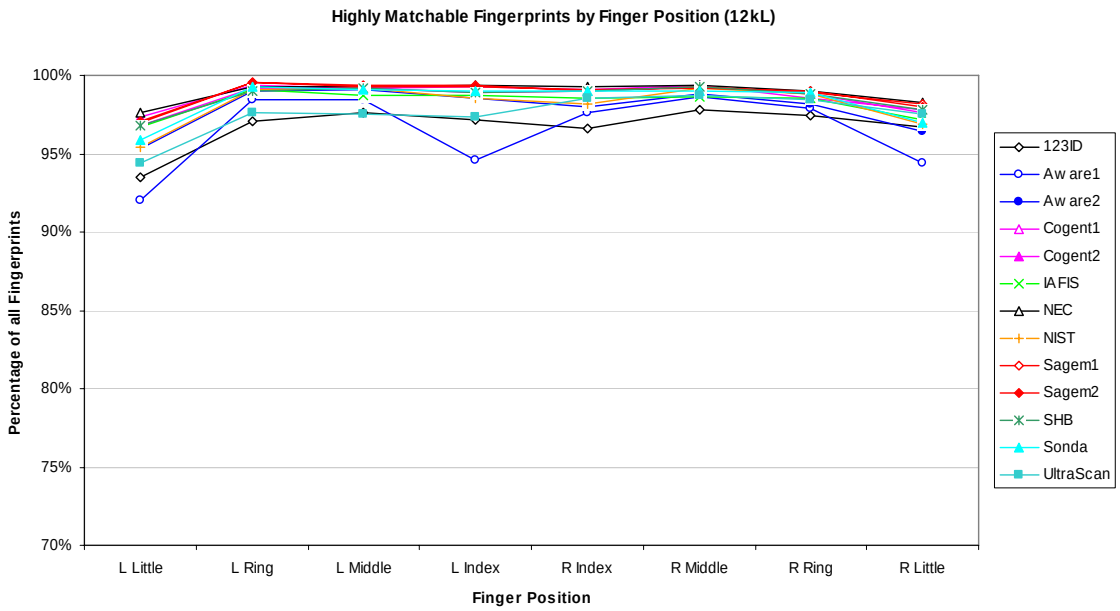

Figure B-2: Percentage of highly matchable fingerprints, for 12kL dataset, by finger position and segmenter

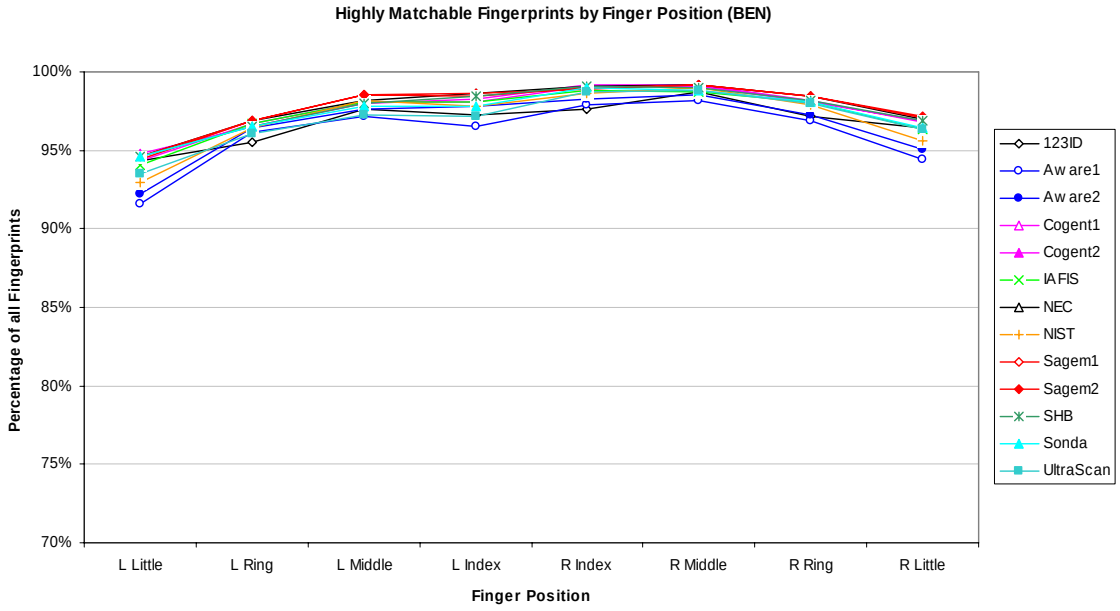

Figure B-3: Percentage of highly matchable fingerprints, for BEN dataset, by finger position and segmenter

It is interesting how some segmenters are affected by different datasets and finger positions. For example, note how some segmenters are less effective on left index fingers for slaps from paper sources (12kP and TX).

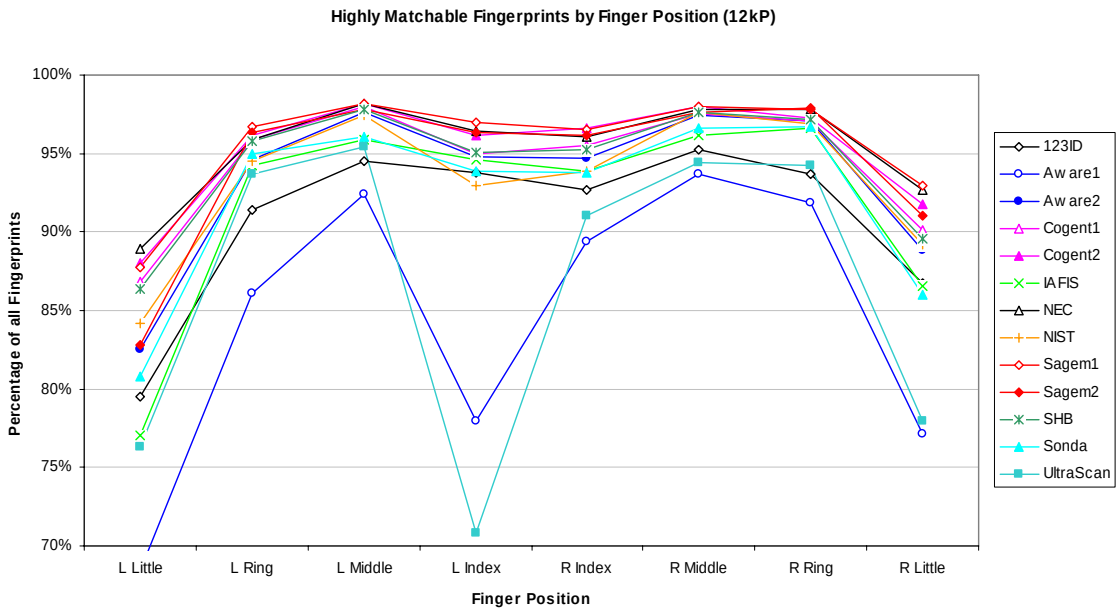

Figure B-4: Percentage of highly matchable fingerprints, for 12kP dataset, by finger position and segmenter

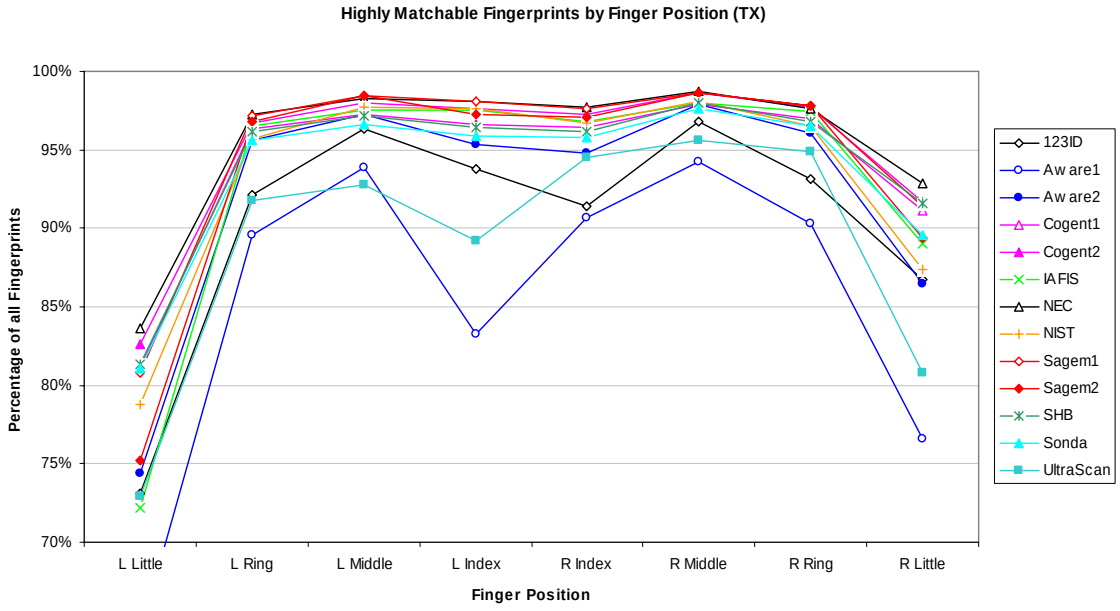

Figure B-5: Percentage of highly matchable fingerprints, for TX dataset, by finger position and segmenter

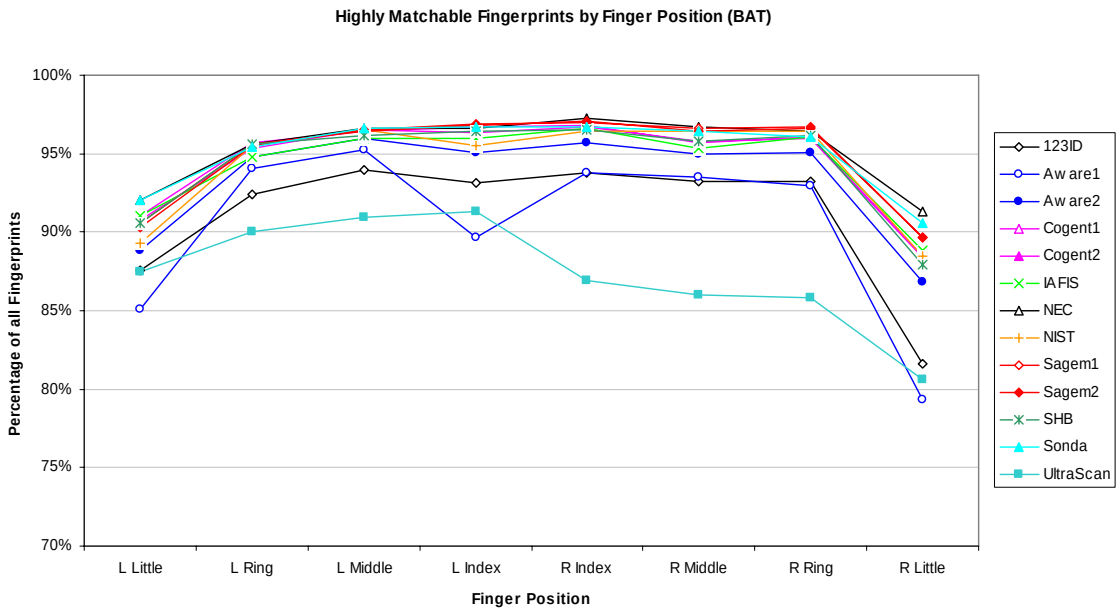

Figure B-6: Percentage of highly matchable fingerprints, for BAT dataset, by finger position and segmenter

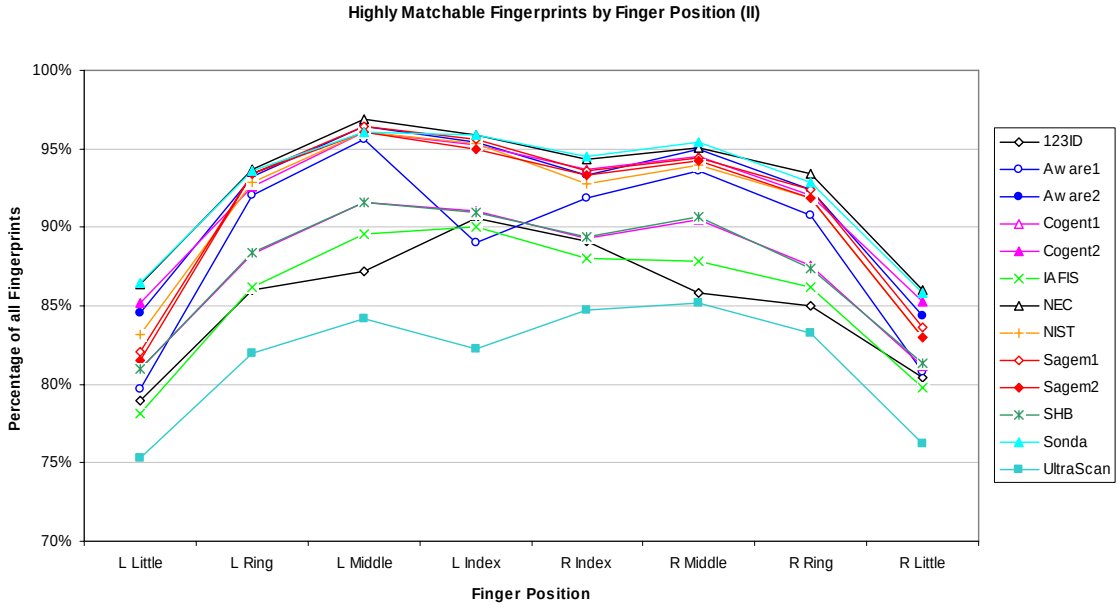

Figure B-7: Percentage of highly matchable fingerprints, for II dataset, by finger position and segmenter

B.2 Effect of Various Scoring Criteria

Figure B-8 shows how the definition of segmentation and matching accuracy affects results, for each segmenter, across all data. The various lines show the results based on differing number of fingers and/or matcher thresholds. These results are computed over all datasets (29,484 slaps).

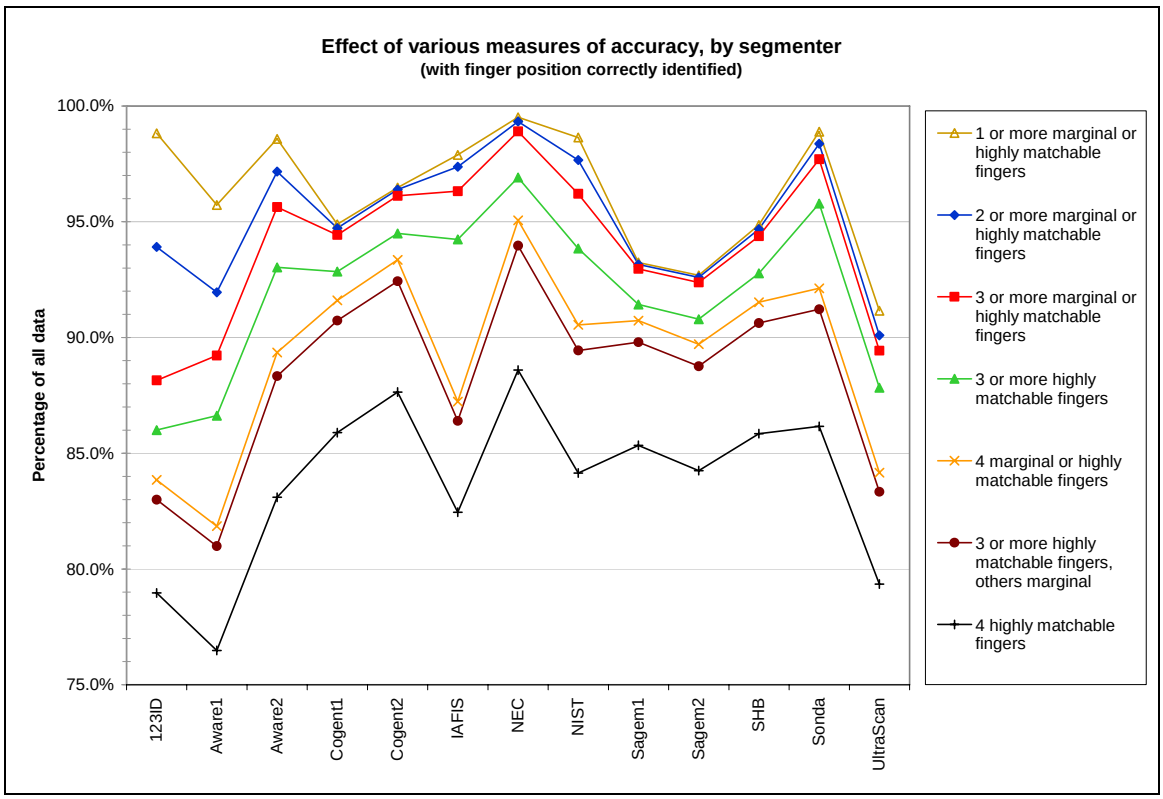

Figure B-8: Comparison of various measures of accuracy by segmenter. All of these measures required finger positions to be correctly identified.

Some segmenters were more effective at identifying finger positions than others. The effect of finger position identification is shown in Figure B-9. The accuracy where the finger position is correctly identified is shown by solid lines; the accuracy where finger position identification is ignored is shown by dotted lines. The solid lines in this chart compare directly to those in Figure B-8. Note that NEC and Sonda are particularly effective at identifying finger positions, even for cases with only two matchable fingers.

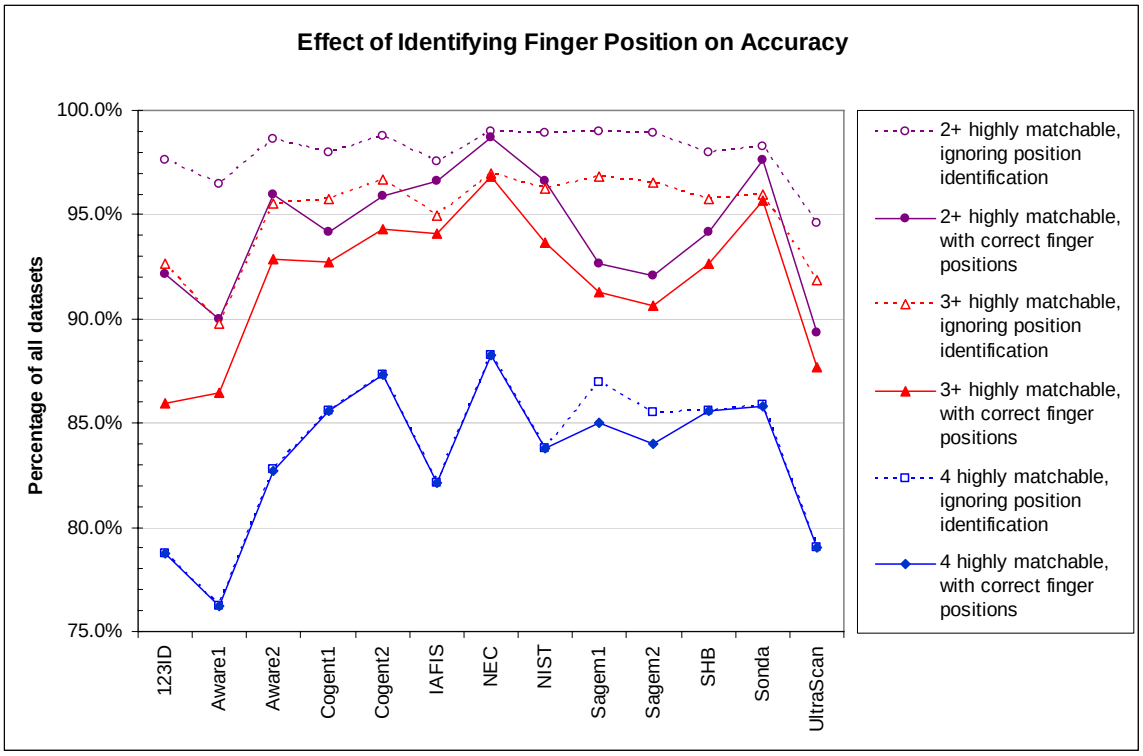

Figure B-9: Effect of finger position identification on accuracy

B.3 Segmenter Return Codes

In the SlapSeg04 API, segmenters were requested to provide standard return codes indicating specific types of processing failures. These codes were helpful in identifying processing errors during the evaluation. In every case where a run resulted in a fatal error, such as those due to I/O problems, the segmenter was rerun on the same data to verify that all errors were repeatable. Table B-1 summarizes the distribution of these codes by segmenter, over all datasets, after corroboration of the results.

	4 Fingers	3 Fingers	2 Fingers	1 Finger	0 Fingers	File Errors	Fatal Errors	Warnings	Non-API codes[1]
123ID	88.2%	8.3%	2.6%	0.4%	0.4%	-	< 0.1%	-	-
Aware1	88.6%	8.9%	1.3%	0.3%	-	-	0.7%	-	0.2%
Aware2	95.8%	3.6%	0.3%	0.2%	-	-	< 0.1%	-	-
Cogent1	95.1%	3.5%	0.2%	< 0.1%	0.8%	-	0.3%	-	-
Cogent2	96.6%	2.9%	0.2%	< 0.1%	< 0.1%	-	0.3%	-	-
IAFIS	91.3%	7.1%	-	1.4%	0.2%	-	-	-	-
NEC	99.0%	0.8%	< 0.1%	0.1%	< 0.1%	-	-	-	-
NIST	100.0%	-	-	-	-	-	-	-	-
Sagem1	96.5%	3.1%	0.2%	0.2%	< 0.1%	-	-	-	-
Sagem2	97.0%	2.5%	0.3%	0.2%	< 0.1%	-	-	-	-
SHB	95.1%	3.5%	0.2%	< 0.1%	0.8%	-	-	-	0.3%
Sonda	96.2%	3.0%	0.7%	0.2%	< 0.1%	-	-	-	-
UltraScan	94.0%	1.5%	< 0.1%	-	4.5%	-	-	-	< 0.1%

Table B-1: Return Codes by segmenter

This information is generally of limited value for evaluation, but may be informative to the participants, especially when compared to the actual success rates. For example, the NIST segmenter reported segmentation of four fingers in every case, but some of those images were blank, had dimensions of zero, or included the wrong fingers.

Figure B-10 shows the same information graphically, and includes as a reference the proportion of the data that contained four matchable fingerprints.

[1] Non-API codes are application-specific error codes.

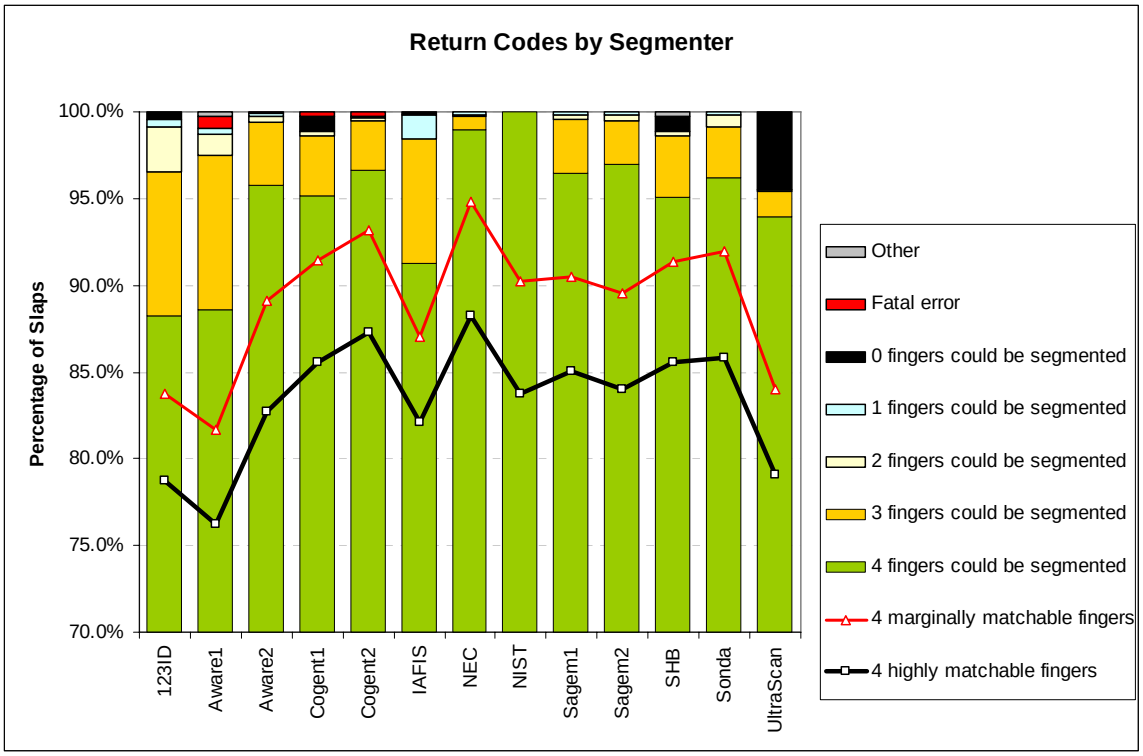

Figure B-10: Return Codes by segmenter

B.4 Ability to Detect Segmentation Failures

This section provides supplemental information related to the SlapSeg04 Analysis Report, Section 4.4, Ability to Detect Problems.

Participants were requested to report a measure of segmentation quality, a user-defined value indicating the likelihood that that image was correctly segmented. The segmentation quality values and the return codes (discussed in the previous section) are both measures that predict varying degrees of segmentation success. Most participants provided segmentation quality values; all segmenters except for NIST provided non-success return codes, as shown in Table B-2.

	Segmentation Quality Values Provided		Non-Success Return Codes Provided	
	Yes	No	Yes	No
123ID		x	x	
Aware1		x	x	
Aware2		x	x	
Cogent1	x		x	
Cogent2	x		x	
IAFIS		x	x	
NEC	x		x	
NIST	x			x
Sagem1	x		x	
Sagem2	x		x	
SHB	x		x	
Sonda	x		x	
UltraScan		x	x	

Table B-2: Segmentation quality values

B.4.1 Segmentation Quality by Segmenter

Figure B-11 through Figure B-23 show the percentage of highly matchable slaps (with correctly identified finger positions) as a function of the Reject Rate for dataset. For further explanation of the methodology by which these charts were generated, please see Section 4.4 in the SlapSeg04 Analysis Report. Note the same results are also shown in Section B.4.2, but with results for each dataset, with one chart per segmenter.

The results in this section (and in Section B.4.2) exclude those cases for which the rolls had serious data errors or quality problems, since in those cases the failure to produce four matchable fingerprints could not have been predicted based on the quality of the slap.

The segmenters that did not provide segmentation quality values (123ID, Aware1, Aware2, IAFIS, and UltraScan) only include three points per line. These points (reading left to right) are defined as follows:

1. **all slaps (excluding rolled problems):**
   the proportion of slaps for which this segmenter returned four highly matchable fingerprints among all slaps
2. **slaps with four images:**
   the proportion of slaps for which this segmenter returned four highly matchable fingerprints among all slaps for which this segmenter returned four segments

3. **slaps with four usable images:**
   the proportion of slaps for which this segmenter returned four highly matchable fingerprints among all slaps for which this segmenter returned four segments, none of which was flagged as nullIQ

All of these charts use the same criteria for the first three points on each line. The subsequent points are based on the segmentation quality criteria provided by each segmenter — if any was provided. For instance, the NIST segmenter assigned three distinct segmentation quality values (1, 3, 5), so in addition to the three points as defined above, there are two more:

4. **slaps with four medium quality images**
   the proportion of slaps for which this segmenter returned four highly matchable fingerprints among all slaps for which this segmenter returned four segments, none of which was flagged as nullIQ, and none of which was assigned a segmentation quality value below 3
5. **slaps with four top quality images**
   the proportion of slaps for which this segmenter returned four highly matchable fingerprints among all slaps for which this segmenter returned four segments, none of which was flagged as nullIQ, and none of which was assigned a segmentation quality value below 5

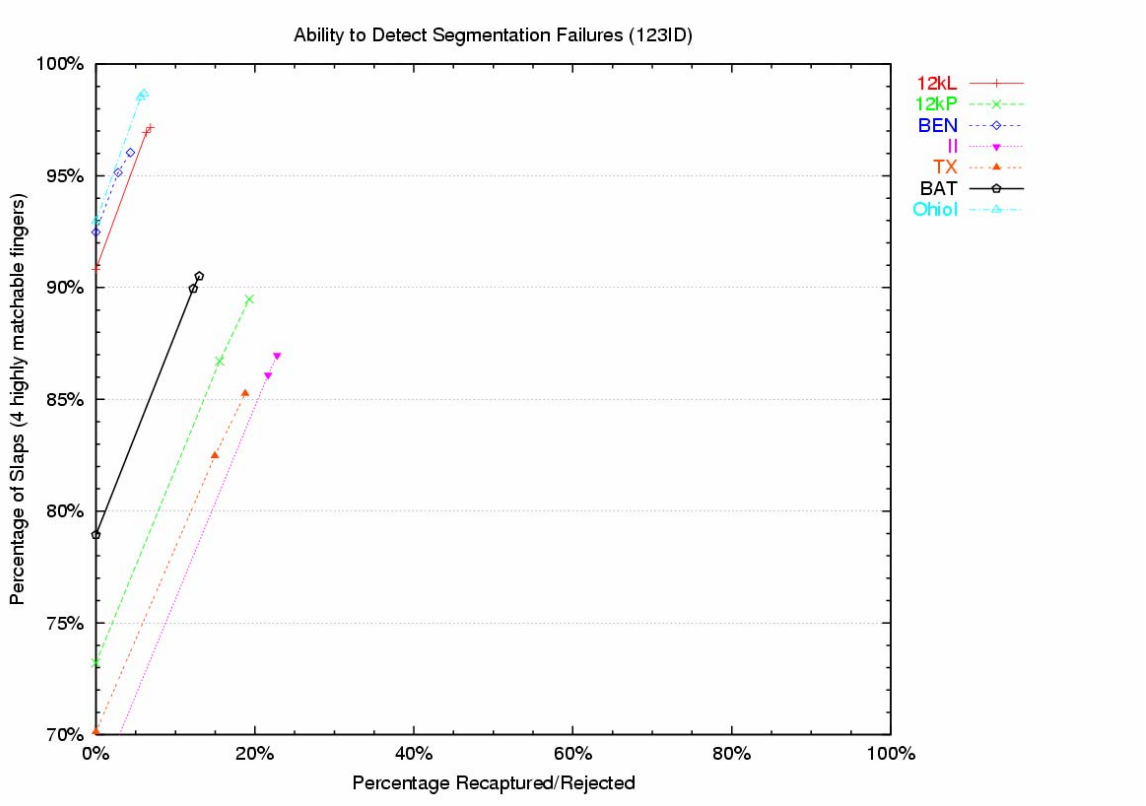

Figure B-11: Accuracy vs. Recapture/Reject rate for 123ID, across all datasets

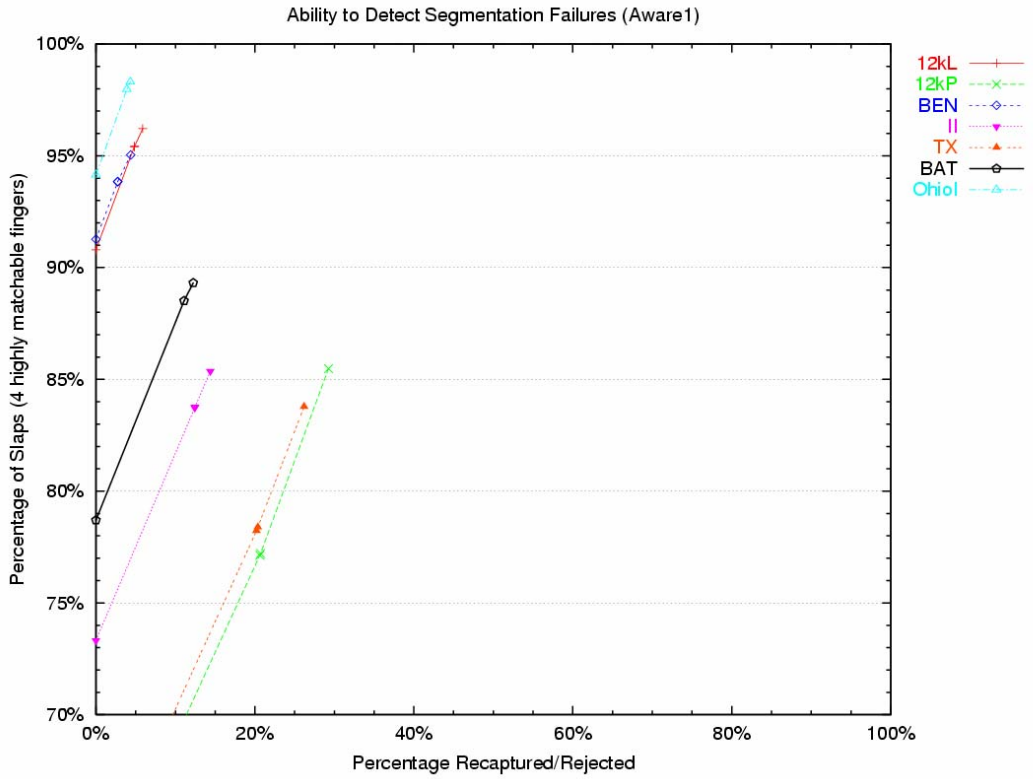

Figure B-12: Accuracy vs. Recapture/Reject rate for Aware1, across all datasets

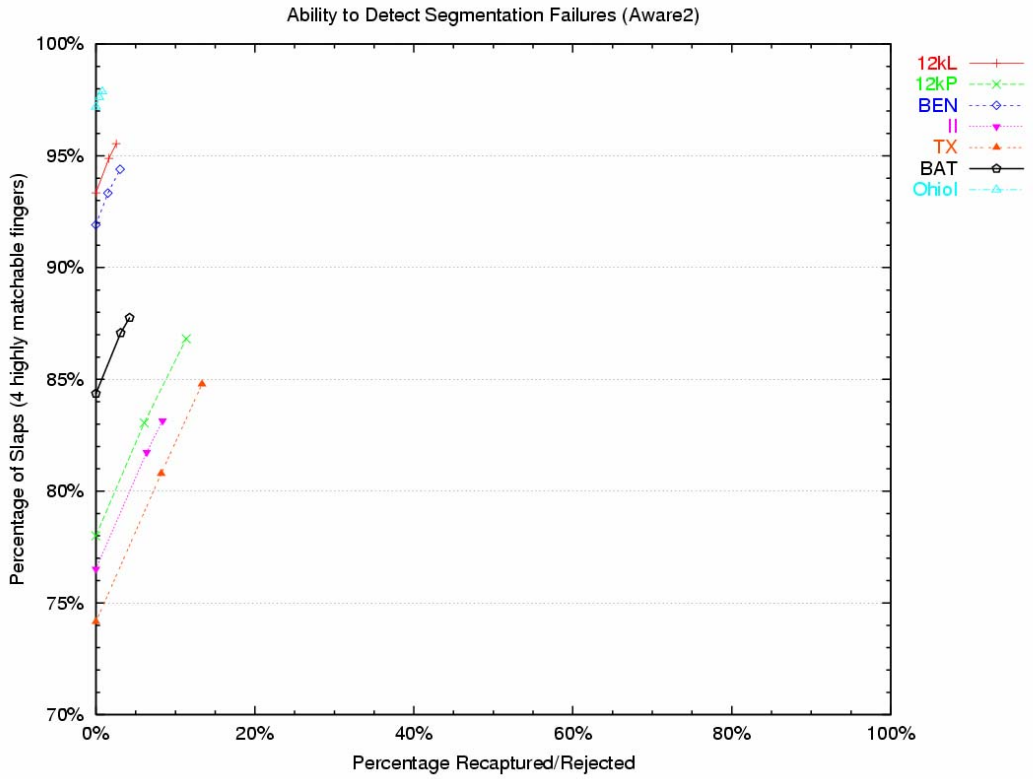

Figure B-13: Accuracy vs. Recapture/Reject rate for Aware2, across all datasets

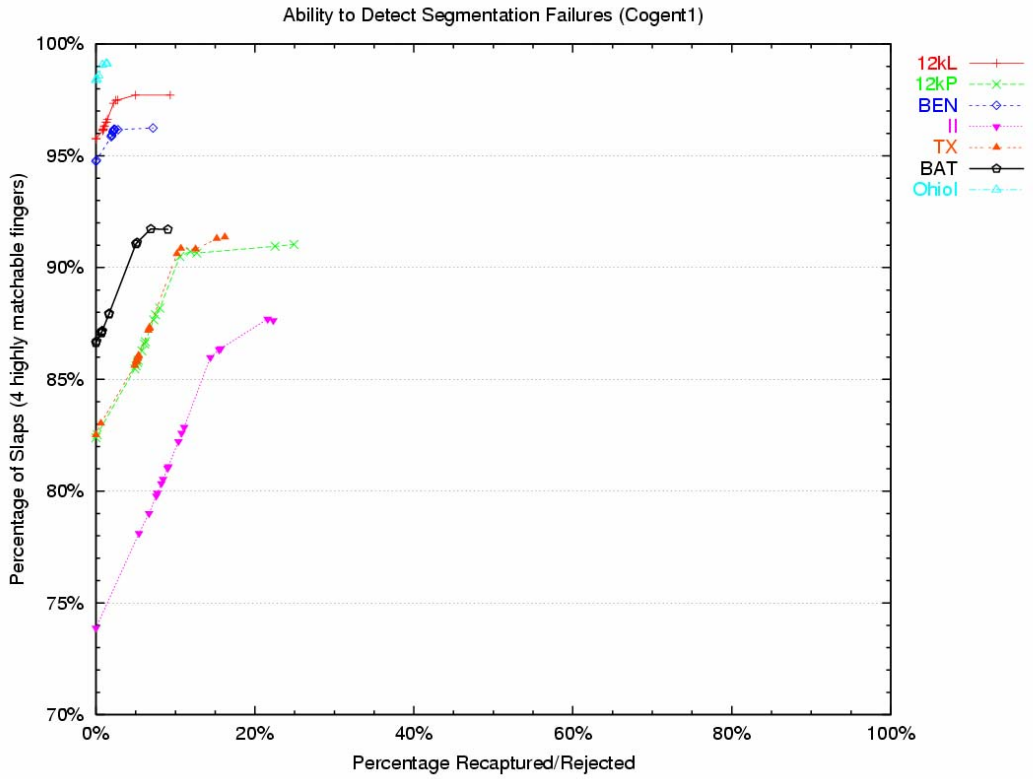

Figure B-14: Accuracy vs. Recapture/Reject rate for Cogent1, across all datasets

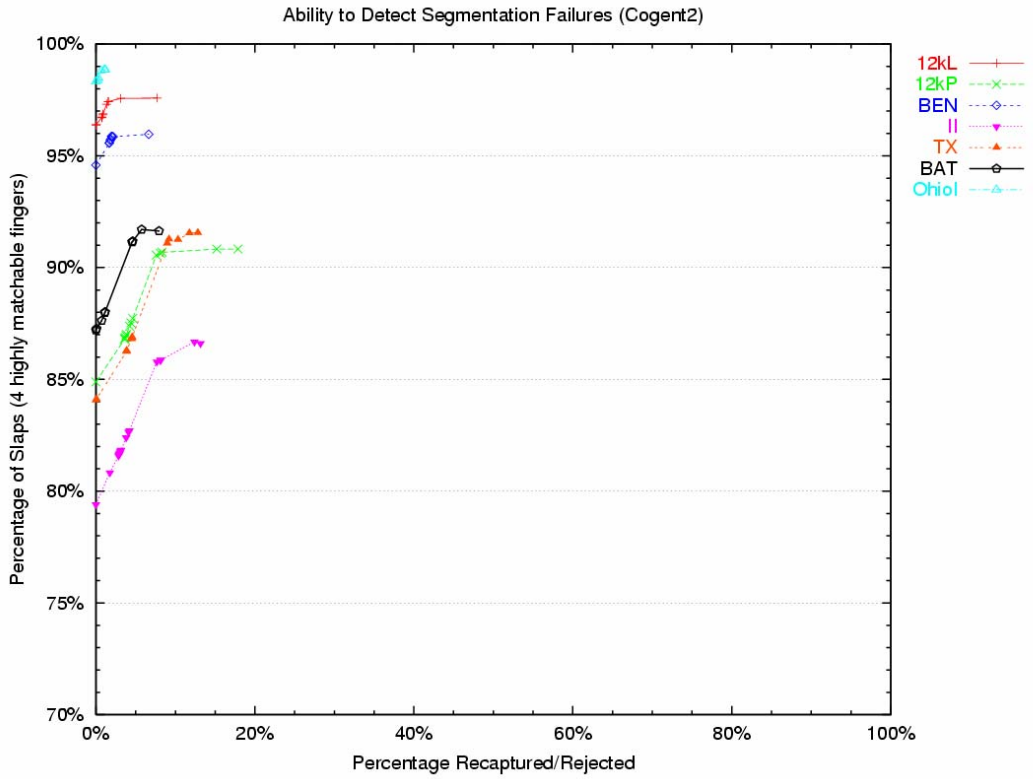

Figure B-15: Accuracy vs. Recapture/Reject rate for Cogent2, across all datasets

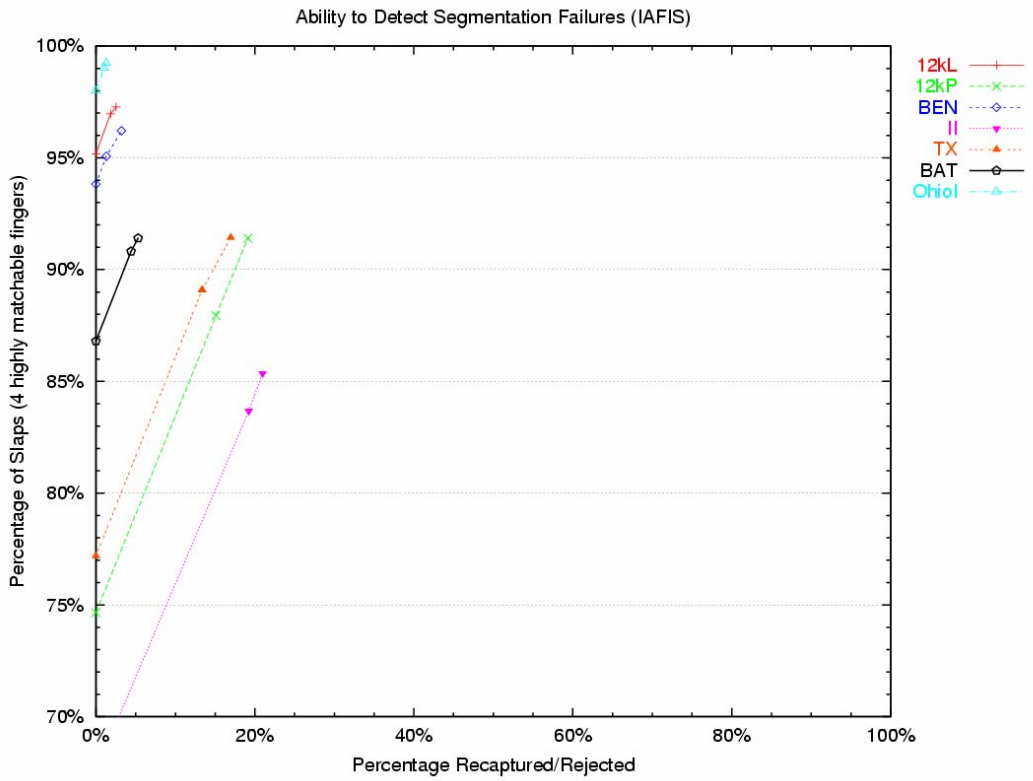

Figure B-16: Accuracy vs. Recapture/Reject rate for IAFIS, across all datasets

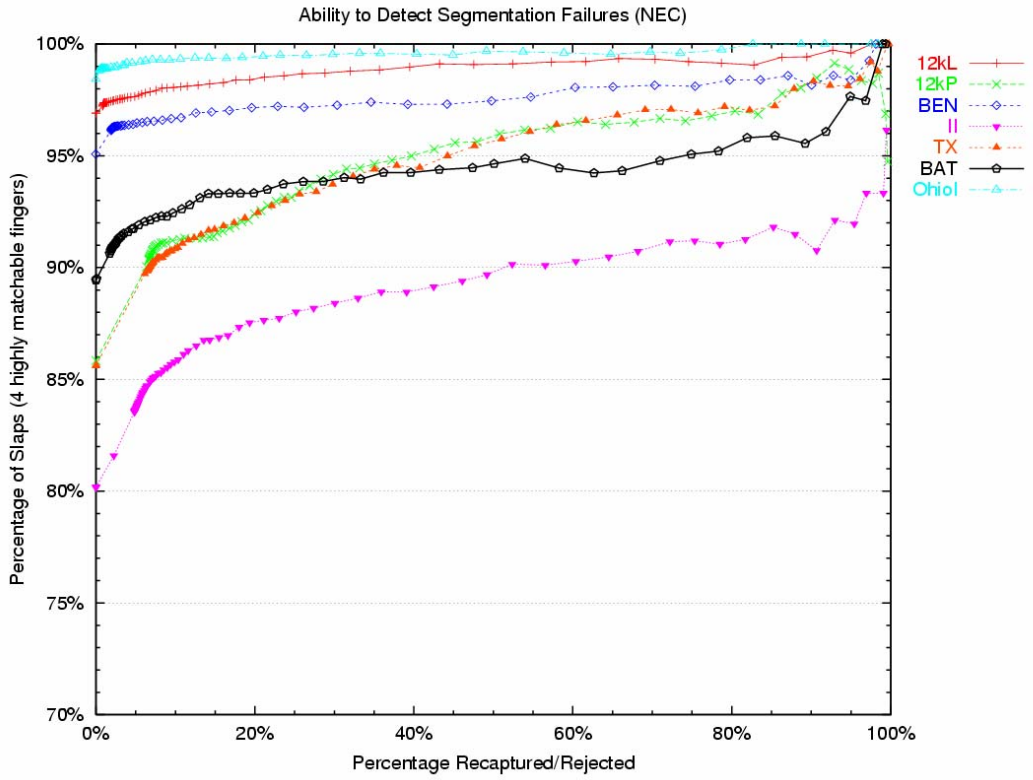

Figure B-17: Accuracy vs. Recapture/Reject rate for NEC, across all datasets

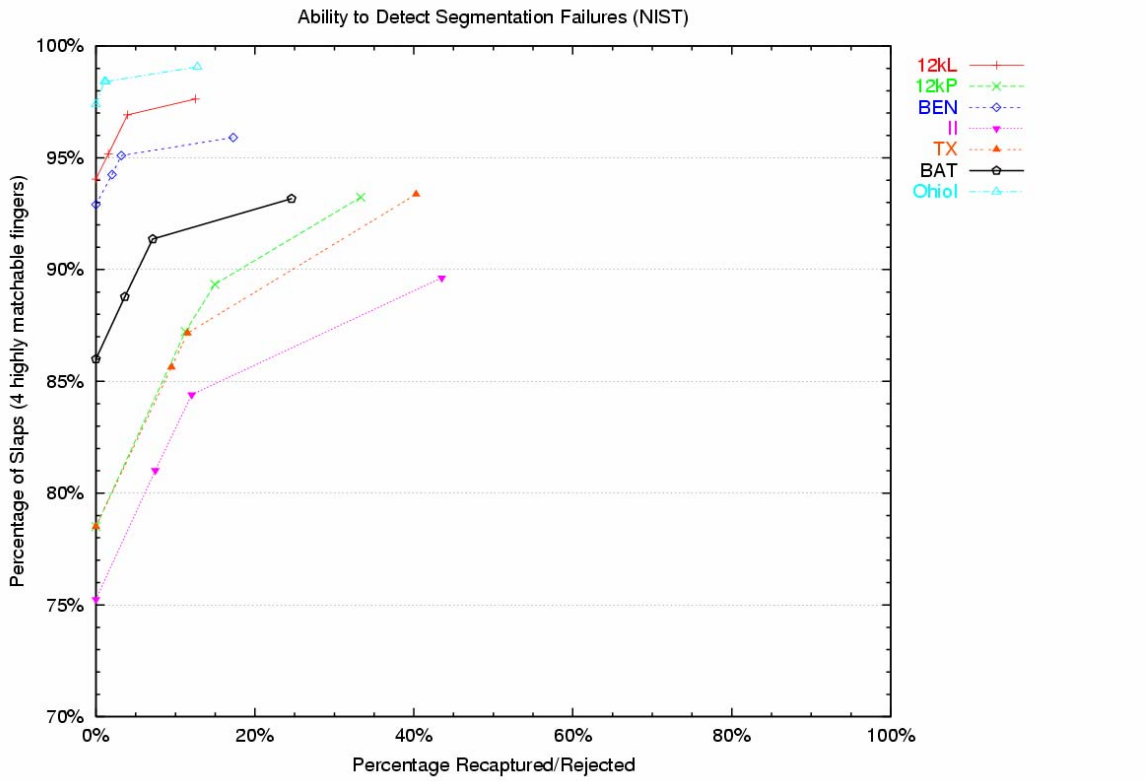

Figure B-18: Accuracy vs. Recapture/Reject rate for NIST, across all datasets

In the Sagem and NEC charts, note the erratic behavior toward the right edge of some of the lines. This indicates that some of the slaps that are classified as having the highest quality still do not include four highly matchable fingers. Such high quality requirements are not likely in many operational environments. Also note that this behavior also reflects a small sample size as the recapture/reject rate approaches 100%, and therefore may be of limited statistical significance.

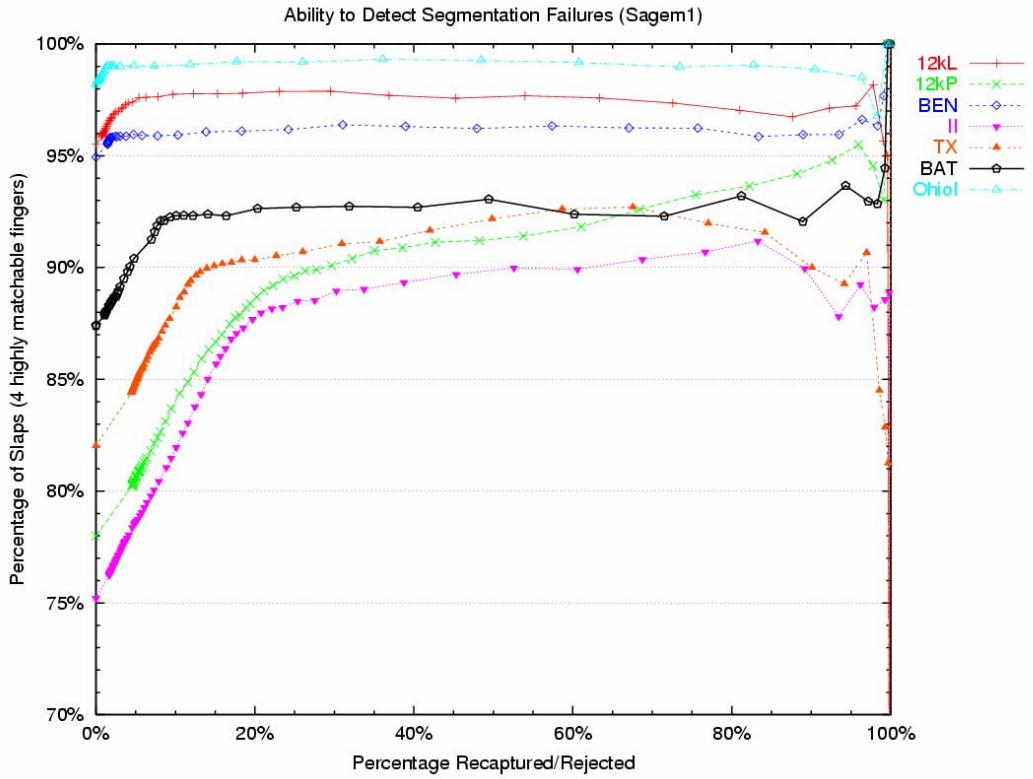

Figure B-19: Accuracy vs. Recapture/Reject rate for Sagem1, across all datasets

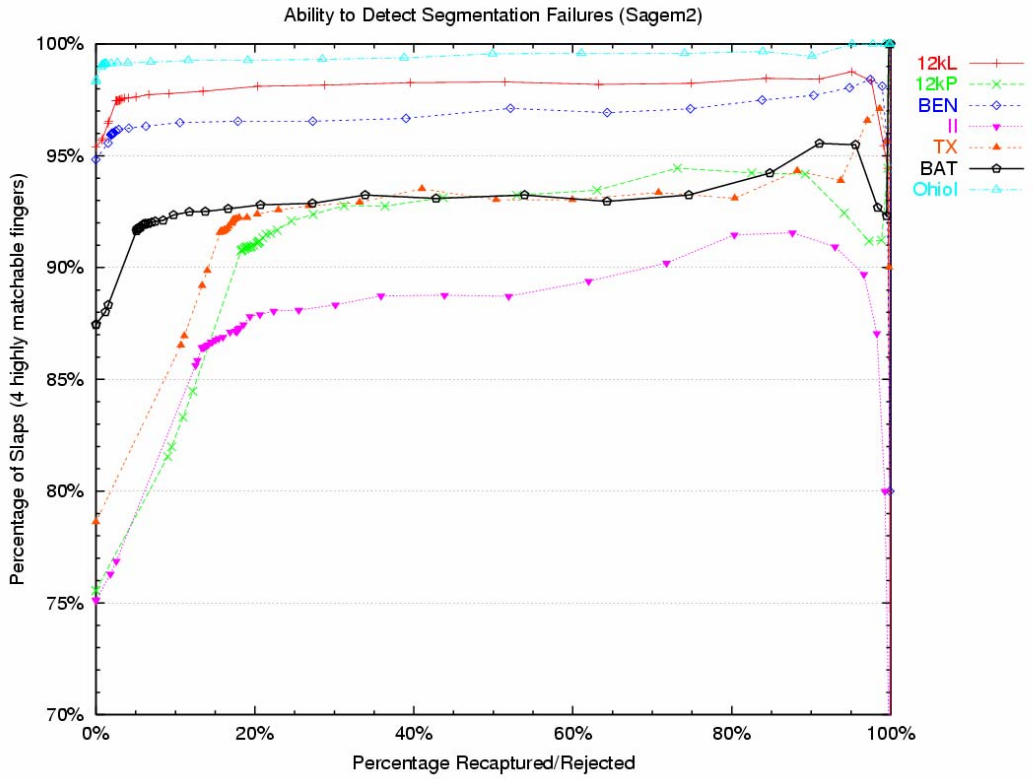

Figure B-20: Accuracy vs. Recapture/Reject rate for Sagem2, across all datasets

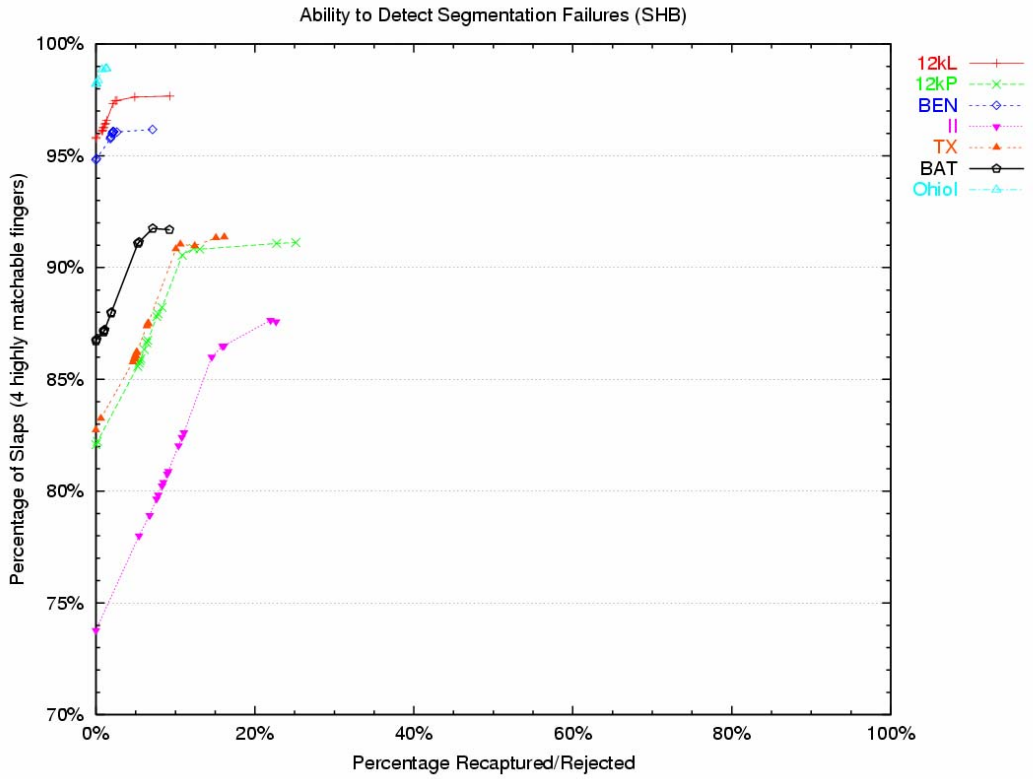

Figure B-21: Accuracy vs. Recapture/Reject rate for SHB, across all datasets

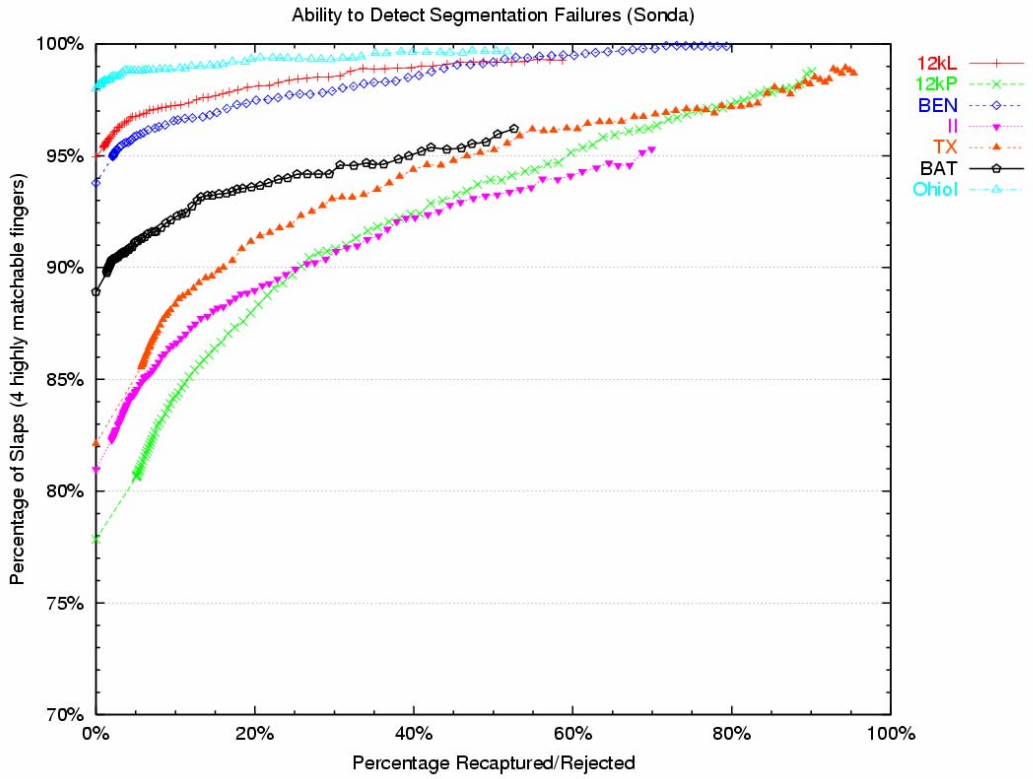

Figure B-22: Accuracy vs. Recapture/Reject rate for Sonda, across all datasets

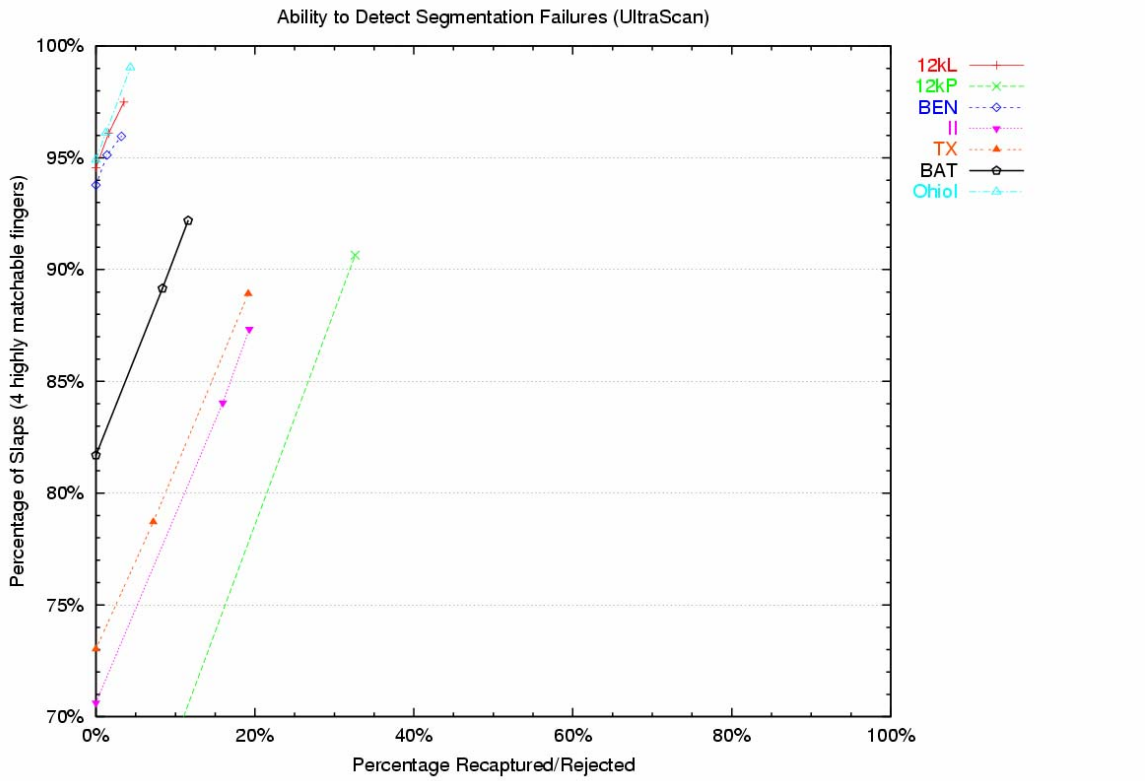

Figure B-23: Accuracy vs. Recapture/Reject rate for UltraScan, across all datasets

B.4.2 Segmentation Quality by Dataset

These charts plot segmentation and matching accuracy vs. recapture/reject rate for each segmenter, with one chart per dataset.

Note that these are the same results as shown in Section B.4.1, but with one chart per dataset, allowing comparisons among segmenters. Note also that the horizontal axis (recapture/reject rate) is limited to 30%.

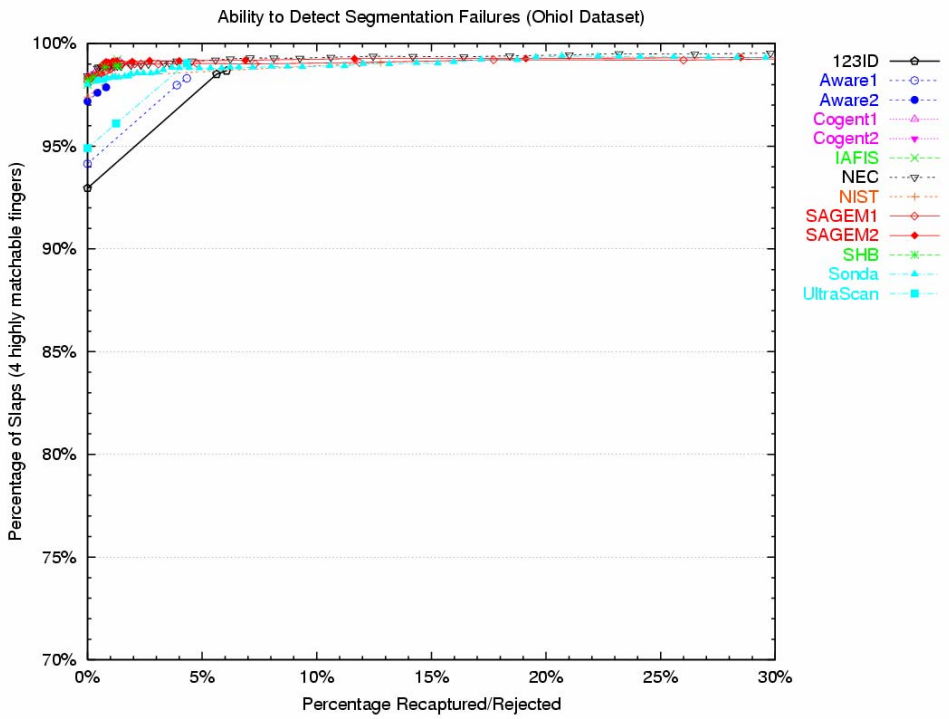

Figure B-24: Accuracy vs. Recapture/Reject rate for the OhioI dataset, across all segmenters

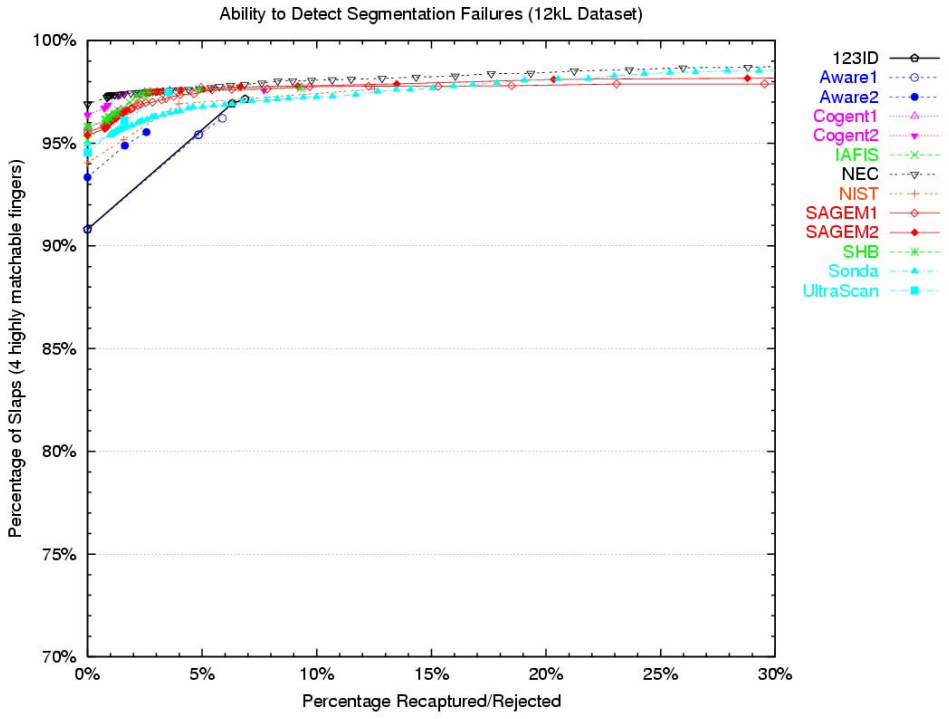

Figure B-25: Accuracy vs. Recapture/Reject rate for the 12kL dataset, across all segmenters

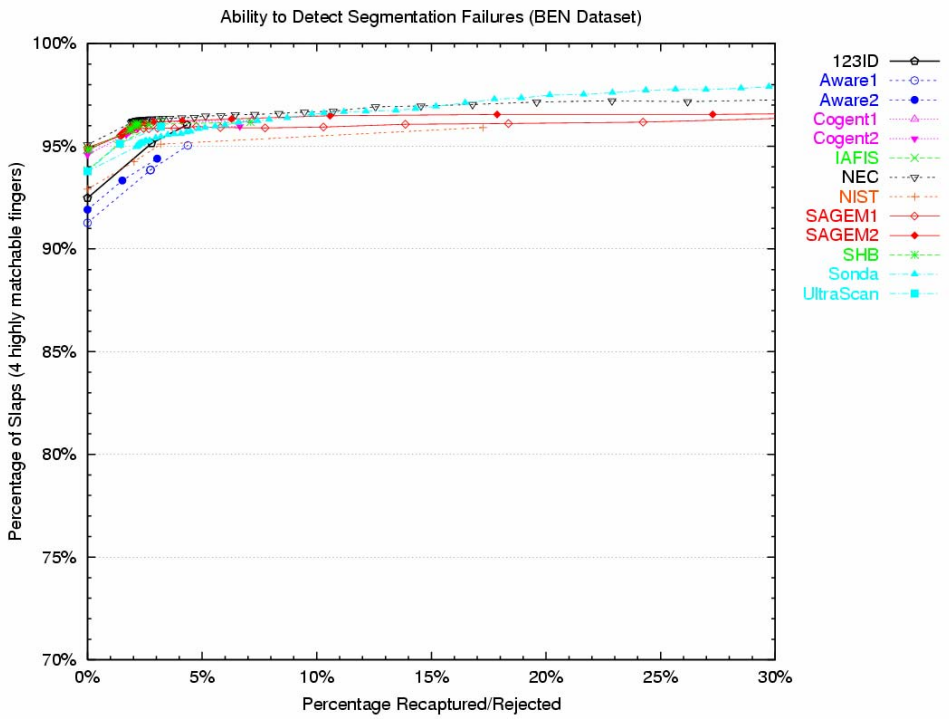

Figure B-26: Accuracy vs. Recapture/Reject rate for the BEN dataset, across all segmenters

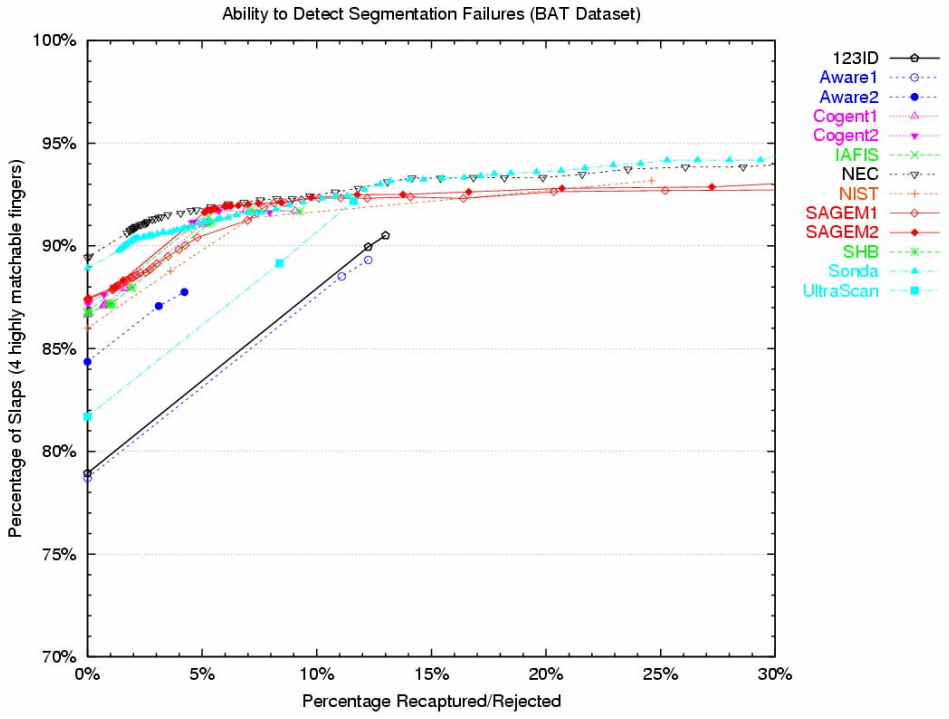

Figure B-27: Accuracy vs. Recapture/Reject rate for the BAT dataset, across all segmenters

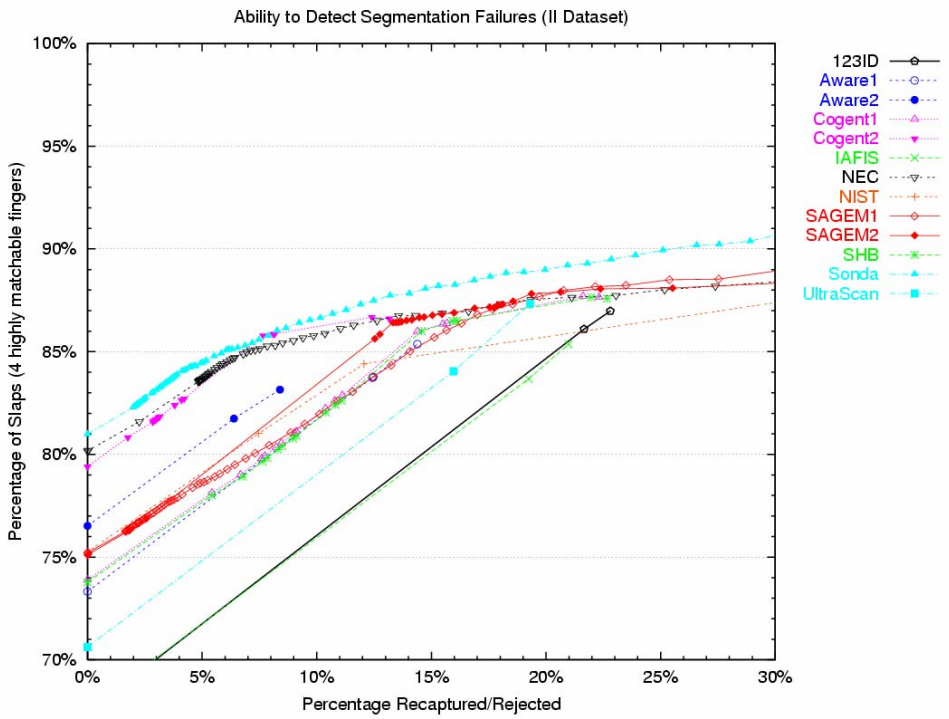

Figure B-28: Accuracy vs. Recapture/Reject rate for the II dataset, across all segmenters

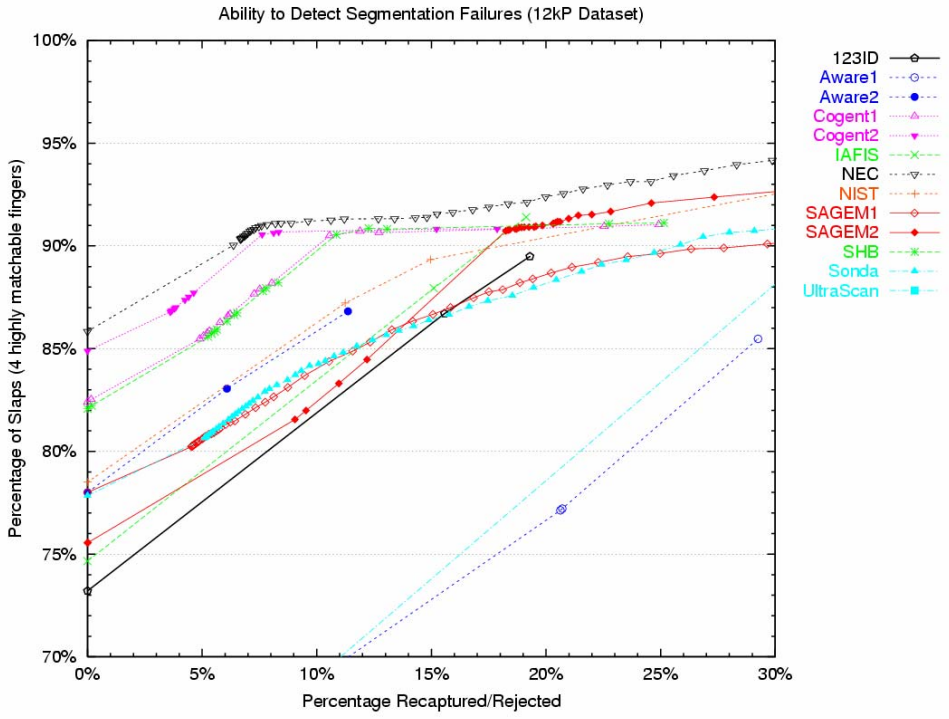

Figure B-29: Accuracy vs. Recapture/Reject rate for the 12kP dataset, across all segmenters

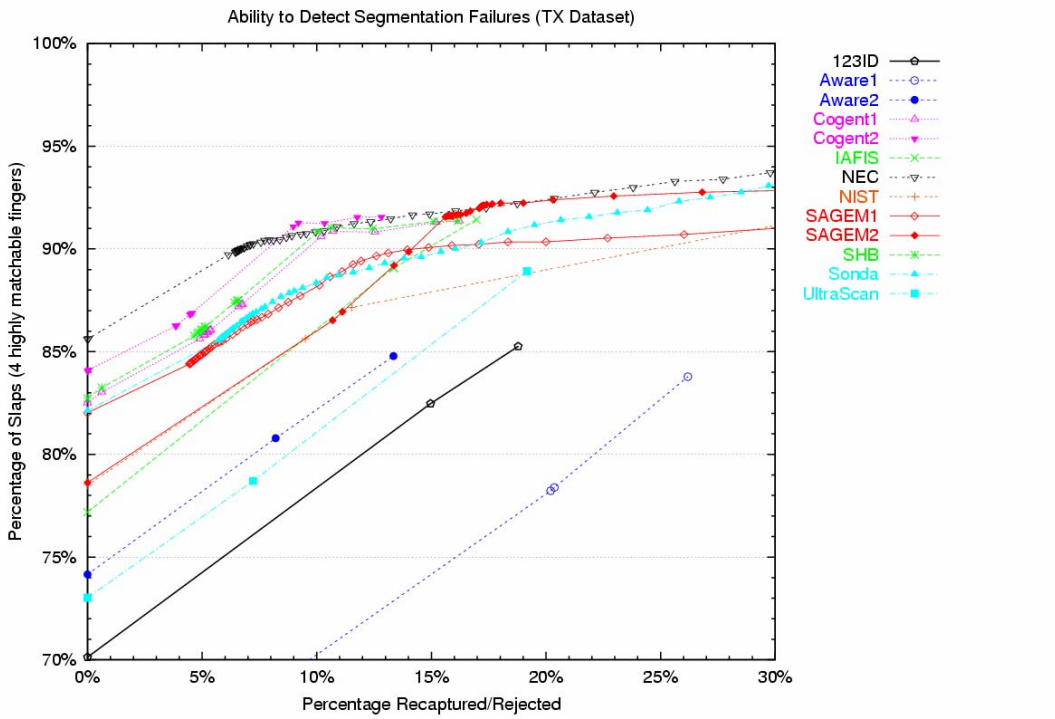

Figure B-30: Accuracy vs. Recapture/Reject rate for the 12kP dataset, across all segmenters

B.5 Choice of Matcher Thresholds

As discussed in The SlapSeg04 Analysis Report, Section 3.2, Evaluation Methodology, high and low score matcher thresholds were used in determining segmentation success.

Thresholds were determined for each matcher, based on the single-finger matching performance for left and right index fingers, across four datasets in the SDK tests:

- High threshold — where the average ROC crosses 10^{-5} (0.001%)
- Low threshold — where the average ROC crosses 10^{-2} (1%)

This is shown graphically in Figure B-31 for one of the matchers. Each type of glyph represents a distinct SDK test. The high and low matcher score thresholds used in the SlapSeg04 evaluation were selected based on these averages from the SDK tests. The actual true and false accept rates (TAR and FAR) resulting from the selection of these thresholds was not measured and is not known with precision.

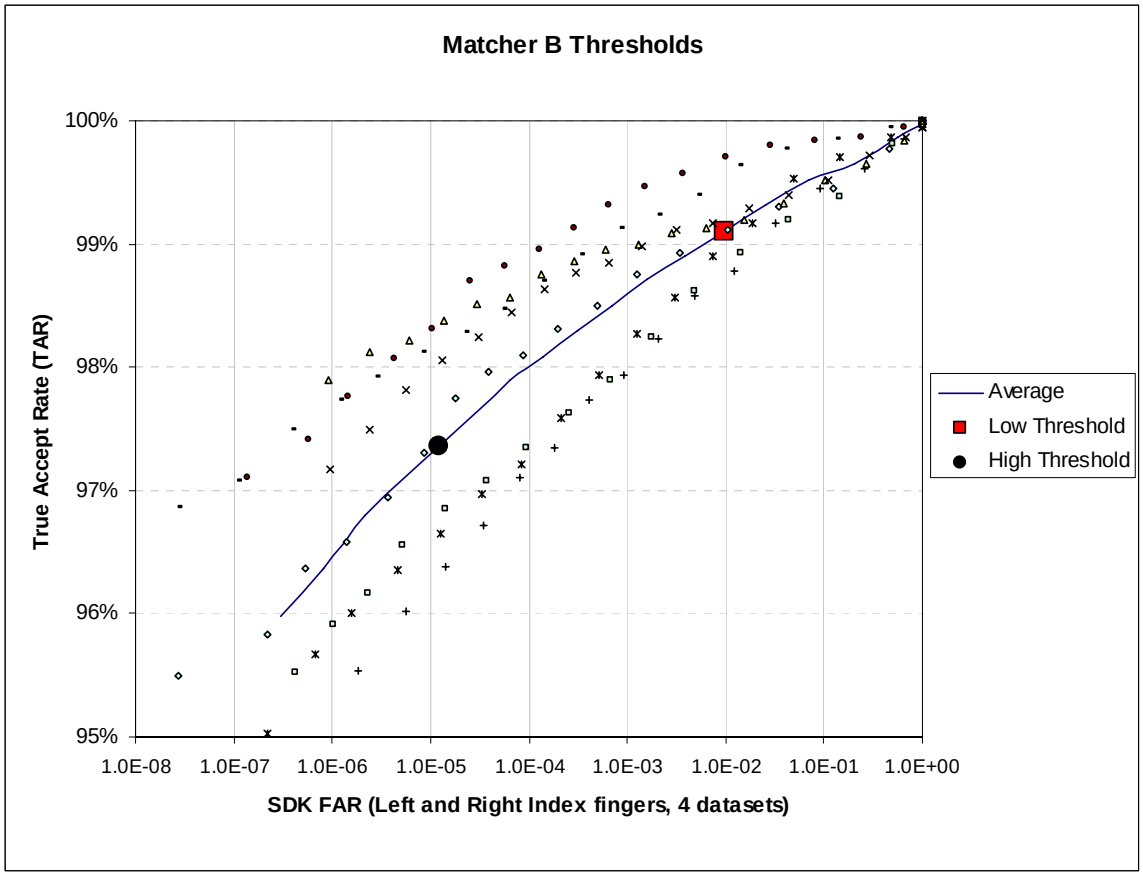

Figure B-31: Determination of matcher thresholds

Table B-3 shows for each of the three matchers used in SlapSeg04 the average TAR as measured on the SDK tests at the high and low FAR values. Note that these are based on a variety of index-finger data from the SDK tests, but are not TAR/FAR values for the SlapSeg04 data itself. These values were used in the design of SlapSeg04 as order-of-magnitude guidelines for matchability, and should only be used for that purpose.

Matcher	Average TAR	
	High Threshold where FAR=10^{-5}	Low Threshold where FAR=10^{-2}
A	98.0%	99.3%
B	97.4%	99.1%
C	95.7%	98.3%

Table B-3: Average FAR/TAR values by threshold for the matchers used in SlapSeg04

B.6 Effect of Choice of Matchers

This section provides supplemental information related to the SlapSeg04 Analysis Report, Section 3.6, Significance of Results.

The way that matchers were used to evaluate the segmenters had some effect on the results. Three matchers were used in the evaluation. A match was determined if a fingerprint matched above high threshold on any of the three matchers. This method limits the effect of any one matcher, but the effect of each matcher relates to its level of accuracy: more of the matches are made by the most accurate matcher, so the "any matcher" rule is affected by the most accurate matcher more than by the others. If all matchers were required to match above high threshold, the results would be affected primarily by the least accurate matcher, and the overall level of accuracy for four-finger matches would drop by about 20%.

If different matchers had been used in the evaluation, or different methods of combining the results had been used, the comparative position of segmenters would change in some cases. This is shown in Figure B-32, which is sorted based on the "Any matcher" rule, but indicates (with red brackets) which segmenters would have swapped places if the "All matchers" rule had been used instead.

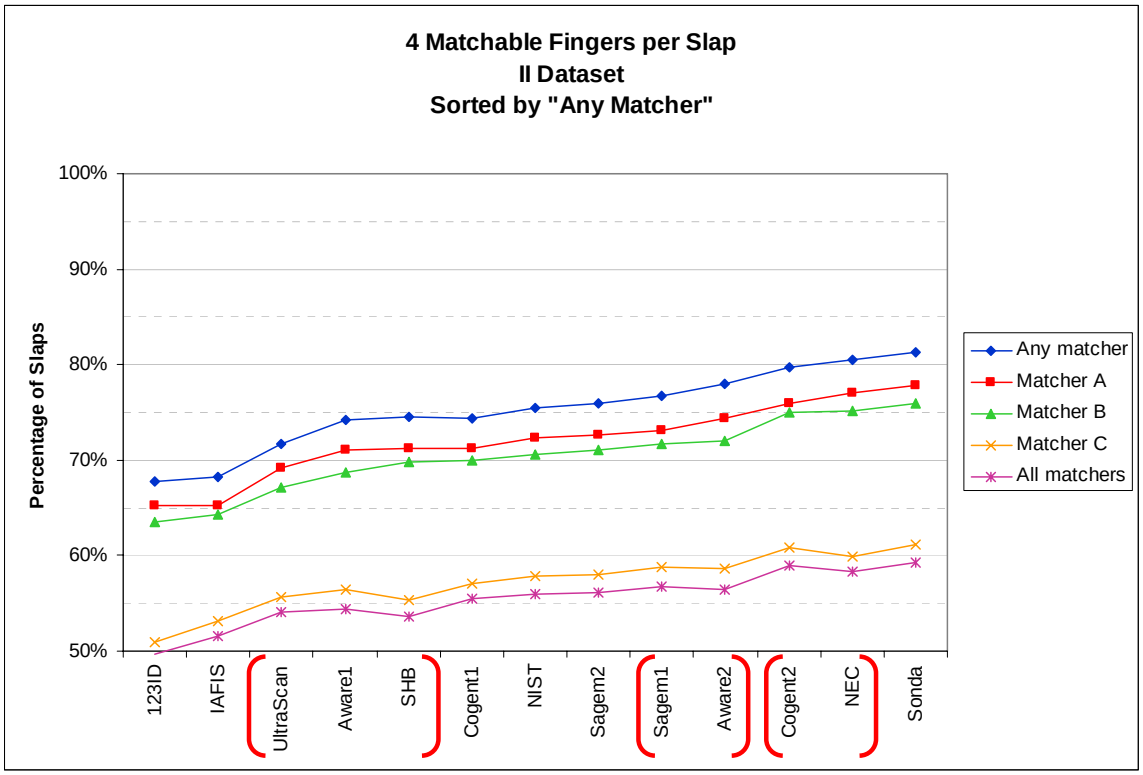

Figure B-32: Results for IDENT/IAFIS dataset, four matchable fingers per slap, sorted using the "any matcher" rule. Segmenters than would have switched places if the "all matchers" rule had been used are indicated in brackets.

B.7 Image Quality

B.7.1 Use of Null Image Quality and NIST Fingerprint Image Quality Metrics

As stated in the SlapSeg04 Analysis Report, Section 4.5.1, Fingerprint Quality Metrics a fingerprint quality metric, "Null Image Quality," (nullIQ) was derived from the NIST NFIQ software. [NFIQ] NullIQ is essentially a subset of the NFIQ5 value. Generally, NFIQ values of 1,2, or 3 are acceptable, and NFIQ values of 4 or 5 are unacceptable.

NullIQ was used instead of an NFIQ value of 5 (NFIQ5) because nullIQ effectively identifies many segmentation and matching failures at a low reject rate, whereas for segmented slap images NFIQ5 (or NFIQ4/5) is effective, but requires a much higher reject rate. This is shown graphically in Figure B-33, which compares different uses of nullIQ, NFIQ5 and NFIQ4/5, showing the rate of detection of slaps with fewer than 4 highly or marginally matchable fingers, in terms of the percentage of good-quality slaps (slaps with four highly matchable fingers) incorrectly identified as being poor quality.

The chart shows that the NFIQ5 measure detects more problems than nullIQ, but rejects much more good data than needed for nullIQ; using NFIQ4 and NFIQ5 together detects more, but at a much greater cost. The appropriateness of each measure for a particular use depends on the comparative requirements for detection vs. tolerance of fingerprints incorrectly classified as poor quality.

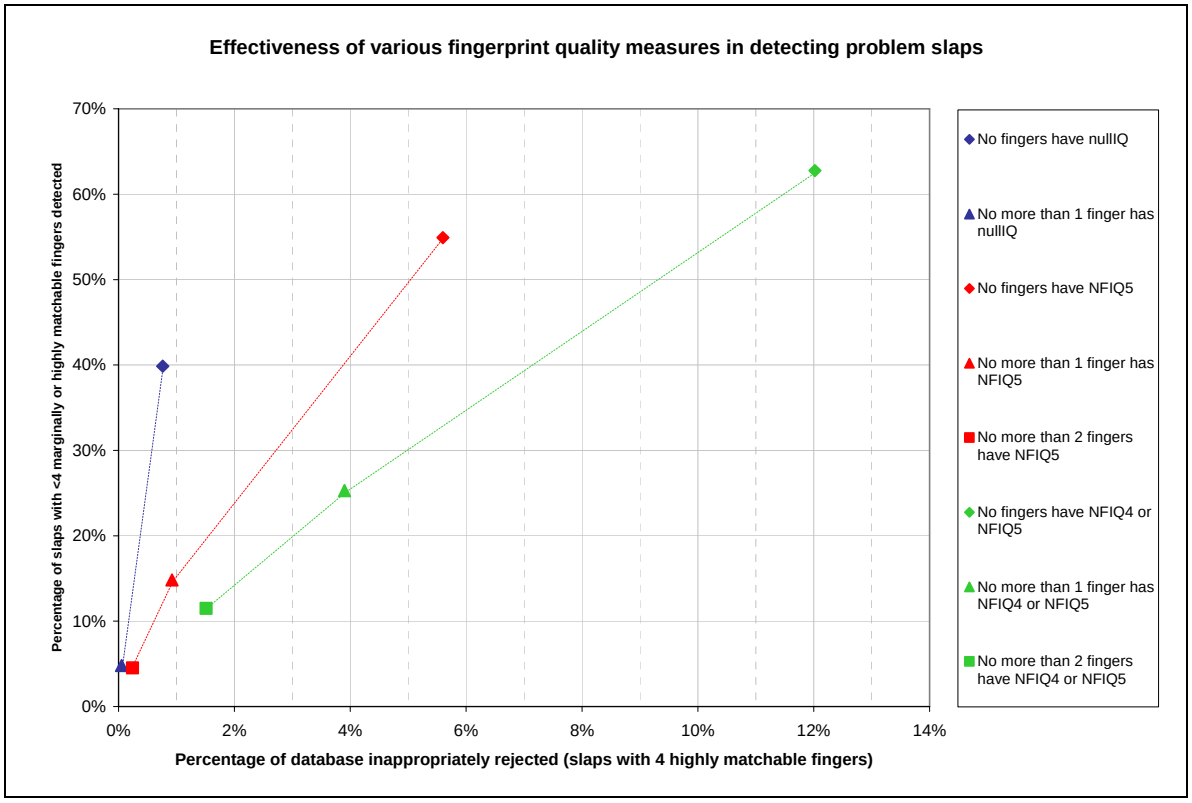

Figure B-33: Effectiveness of NFIQ5, NFIQ4 and nullIQ fingerprint quality metrics for segmented slaps

Figure B-34 shows what the result would have been for Figure 26 in the SlapSeg04 Analysis Report if NFIQ values had been used to determine segmented slap fingerprint quality instead of nullIQ. A far greater proportion of each dataset would have been considered poor

quality, especially for the paper datasets, 12kP and TX. Note the high rate of NFIQ 5 values in the BEN dataset, even though the BEN slaps show high rates of segmentation and matching accuracy.

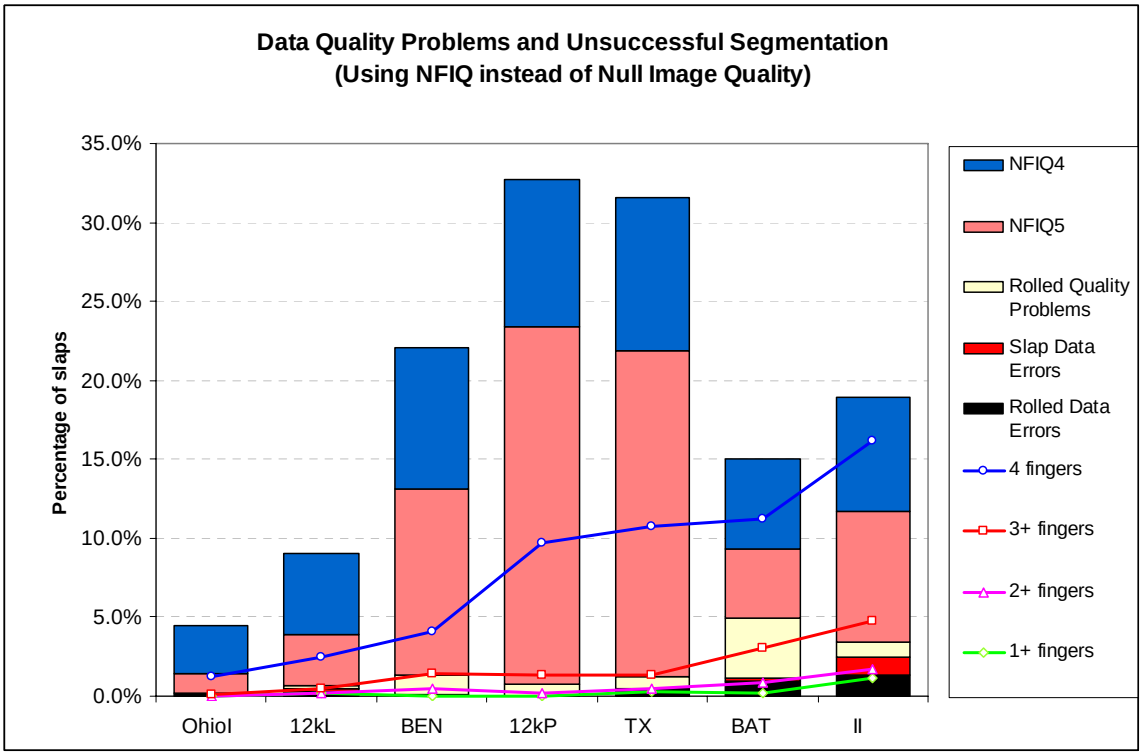

Figure B-34: Relationships between data errors, quality problems, and segmentation failures, using NFIQ instead of nullIQ as an image quality metric. Compare this to Figure 26 in the SlapSeg04 Analysis Report (note the change in the scale for the Y axis)

B.7.2 Distribution of NIST Fingerprint Image Quality (NFIQ) Values

Figure B-35 shows the distribution of NFIQ values for fingerprints segmented from slaps, across all segmenters. Similar results were observed for the most accurate segmenters. These results include all segmented fingers from all slaps, including missegmentations.

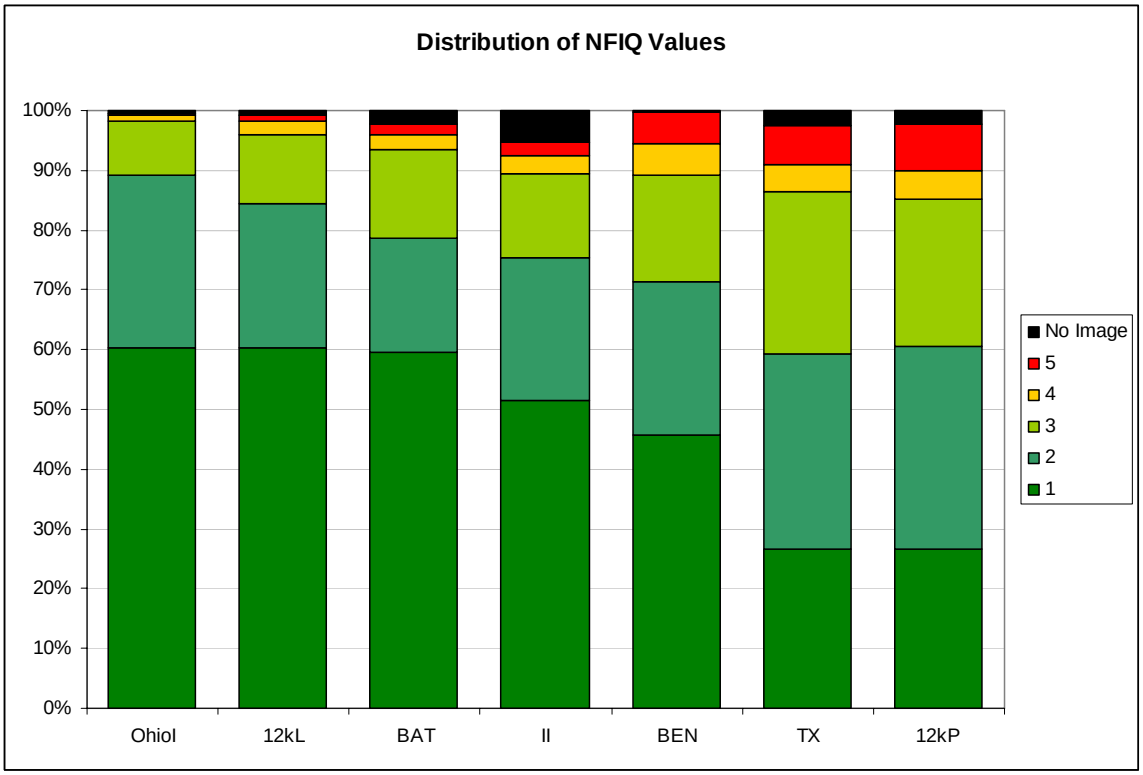

Figure B-35: Distribution of NIST Fingerprint Image Quality (NFIQ) values for fingerprints segmented from slaps, across all segmenters.

Figure B-36 shows the number of good-quality fingerprints (NFIQ 1, 2, or 3) returned per slap, across all data, for each segmenter. Note that these results include all segmented fingers from all slaps, including missegmentations.

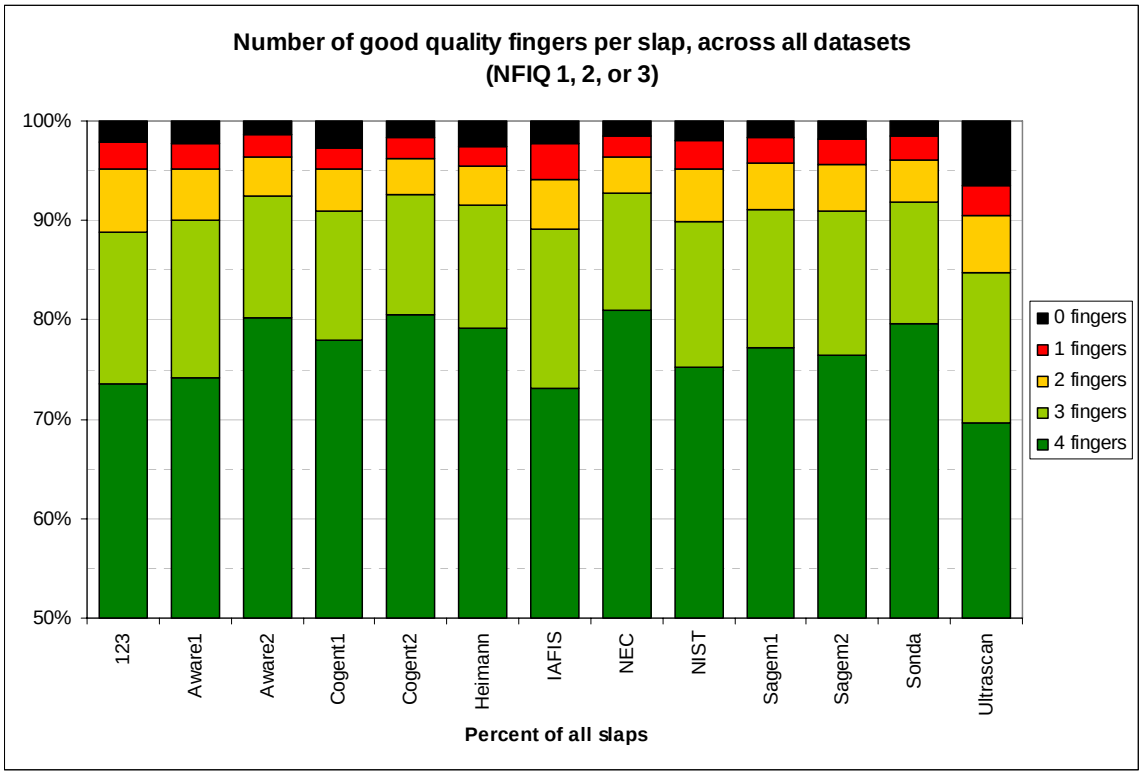

Figure B-36: Number of fingers per slap with good quality (NFIQ 1,2, or 3)

B.8 Groundtruthing

This section provides supplemental information related to the SlapSeg04 Analysis Report, Section 4.5.1, Groundtruthing.

8.1% of the slap/roll sets in the evaluation data contained fewer than four highly matchable fingers (2,380/29,484). Nearly half of these were classified in the groundtruthing process: 639 (2.2%) were manually reviewed, and an additional 453 (1.5%) were flagged by the automated review.

This emphasis on the more problematic slap/roll sets is reflected in the following table:

Number of matchable fingers	Totals	Inspected	Percent
0	89	88	98.9%
1	74	44	59.5%
2	339	179	52.8%
3	1,878	525	28.0%
4	27,104	256	0.9%
Totals	29,484	1,092	3.7%

Table B-4: Extent of groundtruthing

B.8.1 Manual review

Manual review was prioritized to focus on those slap/roll sets that met the following criteria, as determined by the evaluation software:

- Missing rolled image(s)
- A segmented image matched more than one roll OR a roll matched more than one segmented image (priority determined by the number of segmenters with this result)
- None of the segmenters could match a specific finger position at low threshold
- None of the segmenters could match any finger position at high threshold
- Matches off of the expected diagonal (replicated by a majority of segmenters)

B.8.2 Automatic review

Automatic determination of exceptionally poor quality was made for fingerprints with zero good-quality minutiae, or with no areas of good-quality ridgeflow. The NIST NFIS minutiae detector (MINDCT) was used for this purpose. The fingerprint quality metric, "Null Image Quality," (nullIQ) was defined with these rules:

- Zero good-quality minutiae, defined as no minutiae of 50% reliability or better (Min05=0)
- No areas of good-quality ridgeflow, defined as no blocks of Quality Zone 4 (QZone4=0)

Rolled fingerprints were classified as exceptionally poor quality if they met either of these conditions.

Slap fingerprints were classified as exceptionally poor quality if these conditions were replicated by the results from at least 6 of the 13 segmenters.

B.8.3 Groundtruthing details

Figure B-37 shows for each dataset the distribution of problems identified through groundtruthing. As some slap/roll sets were categorized as having multiple problems, the total percentage of slaps having problems is less than the sum of the individual categories. This can be compared to the summary results reported in the SlapSeg04 Analysis Report Section 4.5, Sources of Errors.

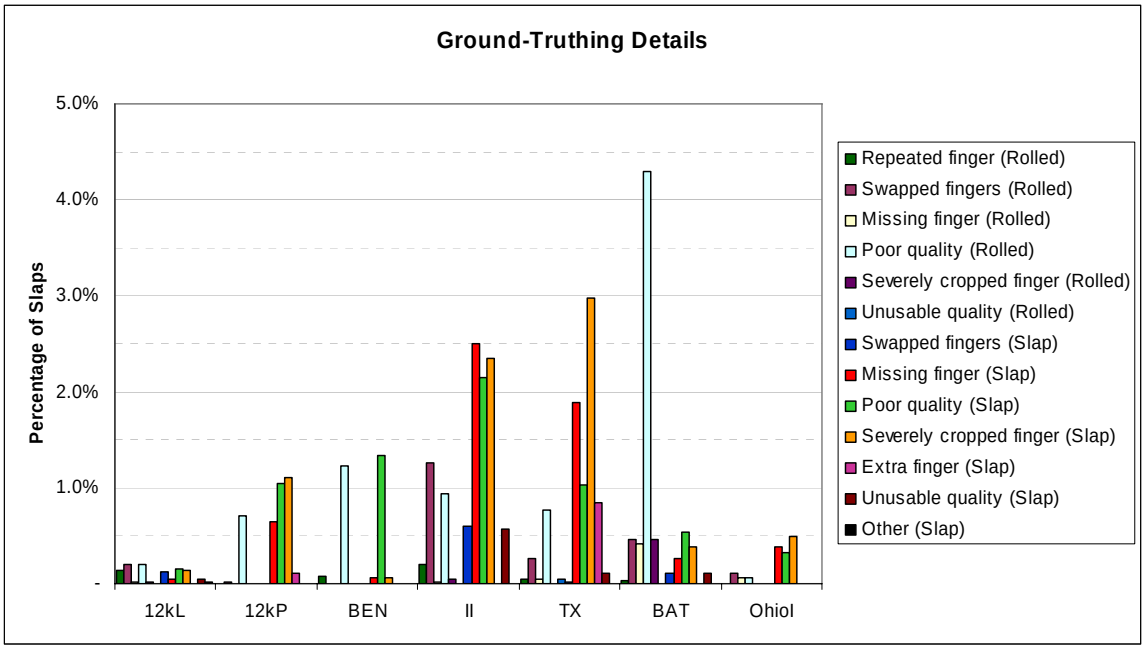

Figure B-37: Groundtruthing details

In Section 4.5 of the SlapSeg04 Analysis Report, partial, missing, cropped, and extra fingerprints were lumped into a single category. Table B-5 breaks down the total into its parts. Note that a given slap often fits into multiple categories. The extra fingers category was limited to slaps from paper sources in which a thumb or other fingerprint overlapped into the slap image.

	Total	Missing Finger	Poor Quality	Partial or Severely Cropped	Extra Finger
BEN	< 0.1%	< 0.1%	< 0.1%	< 0.1%	-
12kL	0.2%	< 0.1%	-	0.1%	-
OhioI	0.5%	0.3%	0.3%	0.5%	-
BAT	0.5%	0.2%	-	0.4%	-
12kP	1.3%	0.6%	0.6%	1.1%	0.1%
II	2.9%	2.4%	1.9%	2.3%	-
TX	3.9%	1.9%	0.6%	3.0%	0.8%

Table B-5: Breakdown of the partial, missing, cropped, or extra print category

B.9 Effect of Rotating Segmented Output

This section provides supplemental information related to the SlapSeg04 Analysis Report, Section 5.6, Effect of Rotating Segmented Output.

In order to evaluate the effects of output rotation, the NIST segmenter was run twice, once with output rotation, once without. Note this effect was only evaluated using the one segmenter; the results might be different for another segmenter. There was no manual verification of whether the NIST segmenter output was rotated correctly.

Comparative analysis of the NIST and NISTR results showed a limited effect on results, as shown in Figure B-38.[2]

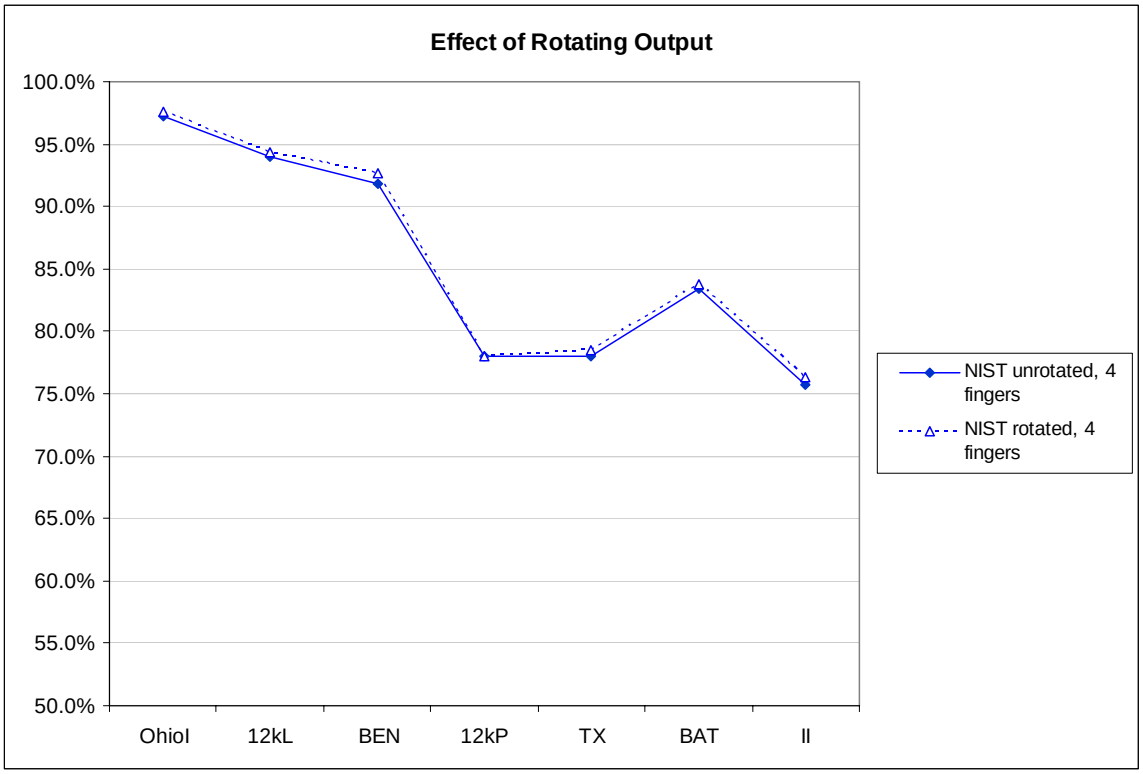

Figure B-38: Effect of rotating output, using the NIST segmenter

Two matchers (A and B) slightly preferred images rotated upright; the other matcher greatly preferred images in the original orientation. Use of the "any matcher" rule for matching minimized this effect.

Details of the effect of rotation are shown in Figure B-39. Using the three highly matchable finger criterion, and excluding database errors, the NIST segmenter usually performed 0.1% to 0.2% better on most datasets when it rotated its output to upright. On the BEN dataset it scored 0.5% higher; note the BEN slaps were the most rotated on average, as shown in the SlapSeg04 Analysis Report, Section 5.2.2. Differences were more pronounced using the 4-finger criteria.

[2] Figure B-38 and Figure B-39 exclude database errors, and a small number of cases on which NISTR crashed.

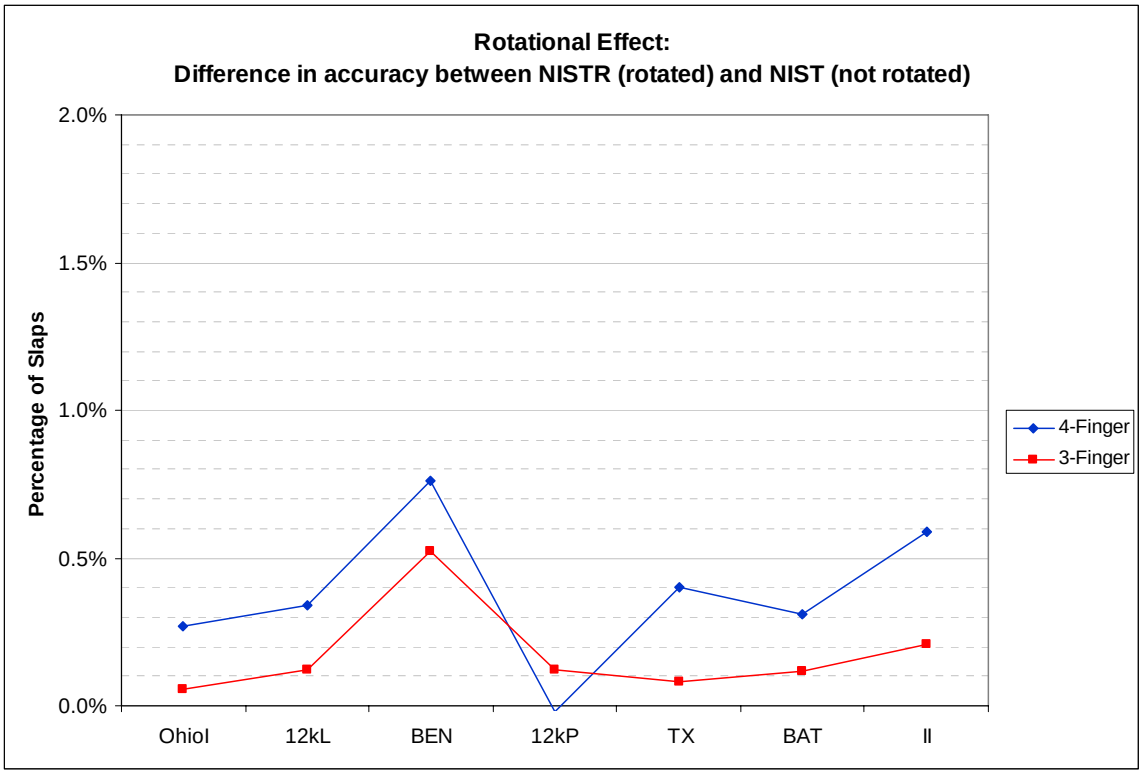

Figure B-39: Effect of rotating output (detail): difference in percentage of highly matchable slaps using rotated and not rotated output

B.10 Effect of Slap Orientation on Segmentation Accuracy

The orientation of slaps (angle of rotation) was found to have little effect on segmentation accuracy.

Small but statistically significant correlations between slap orientation and segmentation accuracy were found in the BAT, II and TX datasets. Likewise, small but statistically significant correlations were found with two of the segmenters: IAFIS and NEC. For these datasets and segmenters, the orientation of the slaps on which segmenters failed differed only slightly from the overall distribution. For the other datasets and segmenters, no correlations between slap orientation and segmentation accuracy were found.

Figure B-40 compares the overall distributions of slap orientations to distributions where failures occurred, for two of the datasets that showed any correlation. Only the right middle and ring fingers are shown, for clarity. The overall distribution is based on slaps where these fingers were matchable on all matchers; the failure distributions are based on individual cases where a segmenter did not succeed on any matcher. Slaps having database errors were excluded, as were slaps on which there was no consensus on slap orientation.

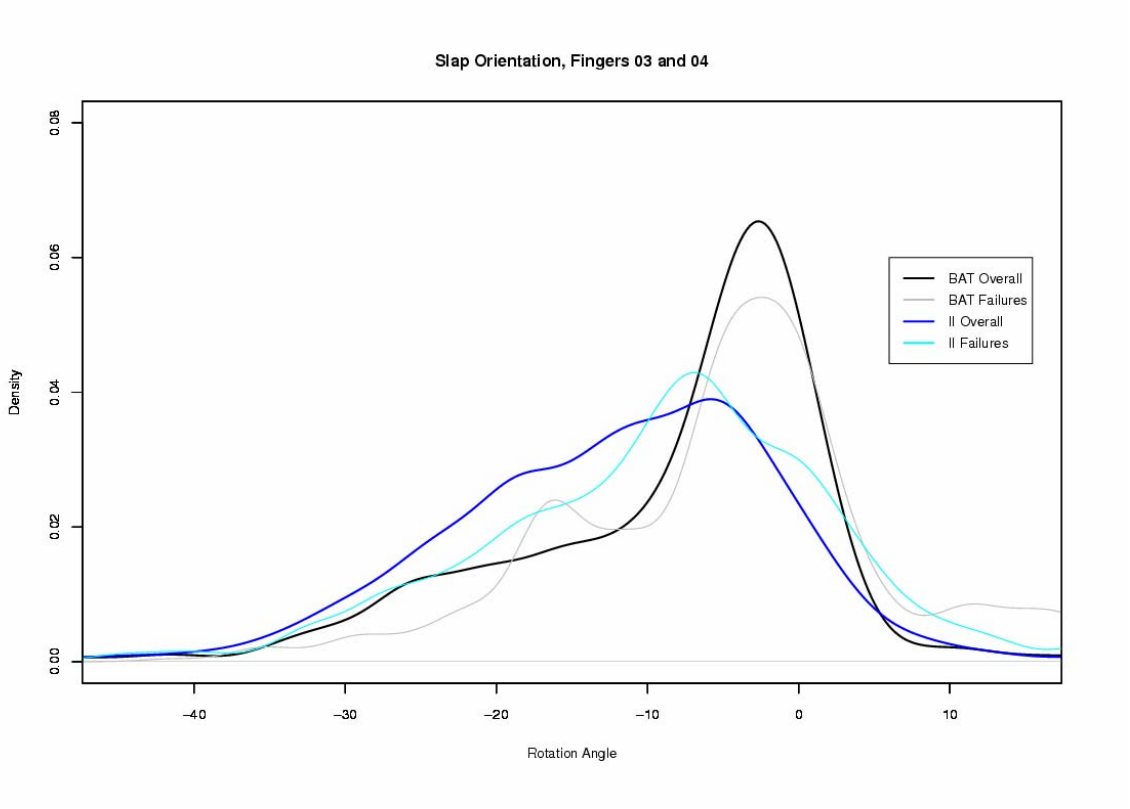

Figure B-40: Effect of slap orientation on segmentation accuracy for BAT and II data.

B.11 DHS Benefits Collection Policy

As mentioned in the SlapSeg04 Analysis Report, Section 3.2, Fingerprint Data, the Benefits dataset was the result of fingerprints that had been captured with well-defined quality control guidelines. As a reference, those guidelines are included here.

The following tables and notes are excerpted from CIS ASC SOP (United States Citizenship and Immigration Services Application Support Center Standard Operation Procedures), Change 7, Module 03, 10 June 03.

Applicant Fingerprinting

Taking the Applicant's Press Prints	
Step	**Action**
1	Check the applicant's hands for texture and softness. If hands are rough, apply Cornhuskers Lotion.
2	Take the applicant's left hand. Place the applicant's left four fingers flat in a 45-degree angle over the slap print glass prism and press the "Capture" button on the control pad.
3	Verify press print clarity.
4	Press the "Yes" button on the control pad to approve the fingerprint and the "No" button to reject the fingerprint. If the fingerprint is approved, the "Flat Left Thumb" screen will appear. If the fingerprint is rejected, repeat step #2.
5	Take the applicant's left hand. Place the applicant's left thumb in the center of the roll print glass prism and press the "Capture" button on the control pad.
6	Verify press print clarity.
7	Press the "Yes" button on the control pad to approve the fingerprint and the "No" button to reject the fingerprint. If the fingerprint is approved, the "Flat Right 4" screen will appear. If the fingerprint is rejected repeat, step #5.
8	Take the applicant's right hand. Place the applicant's right four fingers flat in a 45-degree angle over the slap print glass prism and press the "Capture" button on the control pad.
9	Verify press print clarity.
10	Press the "Yes" button on the control pad to approve the fingerprint and the "No" button to reject the fingerprint. If the fingerprint is approved, the "Right Flat Thumb" screen will appear. If the fingerprint is rejected, repeat step #8.
11	Take the applicant's right hand. Place the applicant's right thumb in the center of the roll print glass prism and press the "Capture" button on the control pad.
12	Verify press print clarity.
13	Press the "Yes" button on the control pad to approve the fingerprint and the "No" button to reject the fingerprint. If the fingerprint is approved, the "Right Thumb Roll" screen will appear. If the fingerprint is rejected repeat step #11.

Notes:

1. If a FP technician determines that s/he cannot capture any fingerprints due to a physical impairment of the applicant, the technician shall refer the applicant to the ASCM for a

possible fingerprint waiver. If the ASCM approves a fingerprinting waiver, the applicant shall be process in accordance with Module 7, "Fingerprint Waivers."

2. If the applicant has an amputation, one or more fingers, thumbs or hand removed, select special options by pressing Special on the Control Pad. Select "MISS" for total amputation. In the case of partial amputation of a finger or thumb, the impression of the remaining end joint is placed in the appropriate block. If an applicant is born with a missing finger, thumb, or hand, select "MISS."

Applicant Fingerprinting

Taking the Applicant's Right Hand Roll Prints	
Step	**Action**
1	Take the applicant's right hand. Place the right thumb in the center of the roll print glass prism. Roll the thumb toward the applicant's body and back to the female or male roll fingerprint start line. Press the "Capture" button on the control pad and roll the right thumb away from the applicant's body, and nail-to-nail over the roll print glass prism.
2	Verify print is classifiable (or best print possible) by determining if ridges and deltas are visible. Press the "Yes" button on the control pad to accept the fingerprint and the "No" button to retake the fingerprint. If the fingerprint is accepted, the "Right Index" screen will appear. If the fingerprint is rejected, repeat step #1.
3	Take the applicant's right hand. Place the right index finger in the center of the roll print glass prism. Roll the finger toward the applicant's body and back to the female or male roll fingerprint start line. Press the "Capture" button on the control pad and roll the index finger away from the applicant's body, and nail-to-nail over the roll print glass prism.
4	Verify print is classifiable (or best print possible) by determining if ridges and deltas are visible. Press the "Yes" button on the control pad to accept the fingerprint and the "No" button to retake the fingerprint. If the fingerprint is accepted, the right middle fingerprint screen will appear. If the fingerprint is rejected, repeat step #3.
5	Repeat steps 3 and 4 for the right middle, ring, and little fingers, in that order.

Notes:

1. The top of the each screen will indicate the finger to roll and an arrow will indicate the recommended direction of the roll for the indicated finger.

2. The prism should be cleaned with a white cloth between prints.

Applicant Fingerprinting

Taking the Applicant's Left Hand Roll Prints	
Step	**Action**
1	Take the applicant's left hand. Place the left thumb in the center of the roll print glass prism. Roll the thumb away from the applicant's body and back to the female or male roll fingerprint start line. Press the "Capture" button on the control pad and roll the left thumb toward the applicant's body, and nail-to-nail over the roll print glass prism.
2	Verify print is classifiable (or best print possible) by determining if ridges and deltas are visible. Press the "Yes" button on the control pad to accept the fingerprint and the "No" button to retake the fingerprint. If the fingerprint is accepted, the "Left Index" screen will appear. If the fingerprint is rejected repeat step #1.
3	Take the applicant's left hand. Place the left index finger in the center of the roll print glass prism. Roll the finger away from the applicant's body and back to the female or male roll fingerprint start line. Press the "Capture" button on the control pad and roll the index finger toward the applicant's body, and nail-to-nail over the roll print glass prism.
4	Verify print is classifiable (or best print possible) by determining if ridges and deltas are visible. Press the "Yes" button on the control pad to accept the fingerprint and the "No" button to retake the fingerprint. If the fingerprint is accepted, the left+ middle fingerprint screen will appear. If the fingerprint is rejected repeat step #3.
5	Repeat steps 3 and 4 for the left middle, ring, and little fingers, in that order.
6	The "Capture photos?" screen will appear.
7	Use the mouse to click "No" or use the up and down function keys on the keyboard to select "No" and press the "Enter" key on the keyboard.
8	The "Capture Choice Applicant, 1 FD258 Card" screen will appear with the applicant's 14 fingerprints.

Note: The prism should be cleaned with a white cloth between prints.

Applicant Fingerprinting

FP Technician's Quality Assurance (QA) Check	
Step	**Action**
1	Verify fingerprints are classifiable (or best possible) by determining if ridges and deltas are visible.
2	Verify fingerprints are rolled nail-to-nail in top 10 blocks.
3	Verify fingerprints are not smudged and in the proper order.
4	Verify press-prints clarity and that the total numbers of press-prints equal the total number of rolled fingerprints.
5	If Special Options are used in cases of missing digits, verify "missing" or "not taken" is visible in lieu of a fingerprint in the appropriate blocks of Form FD-258.
6	If there is a problem, use the mouse or the up/down function keys to select "ReCapture" and press the "Enter" key on the keyboard. Use the up/down function keys on the keyboard to move the green highlight box to the unacceptable fingerprint box. Press "Yes" on the control pad to select the unacceptable fingerprint and that fingerprint screen will appear. Repeat the appropriate steps in "Taking the Applicant's Press Prints," "Taking the Applicant's Right Hand Roll Prints" and/or "Taking the Applicant's Left Hand Roll Prints." Press "No" on the control pad to exit the fingerprint image selection.
7	Repeat step #5 for all unacceptable fingerprints.
8	Record the ASC/COLO site code, today's date, and your six-digit employee number in the AIW "Local AIW Stamp" block.
9.	Summon a quality assurance (QA) specialist, Site Supervisor, or ASCM to conduct a quality assurance review
10.	Provide the applicant a customer service card and request the applicant to complete the customer service card (answer any questions the applicant may have regarding the customer service card while waiting for the Quality Assurance specialist).

Quality Assurance (QA) Review

QA Specialist's Quality Assurance Check of the Applicant's Fingerprints	
Step	**Action**
1	Verify all fingerprints are classifiable (or best print possible) by determining if ridges and deltas are visible. (See QA criteria in Note 1 below.)
2	Verify fingerprints are rolled nail-to-nail in top ten blocks.
3	Verify fingerprints are not smudged and in the proper order.
4	Verify press-prints clarity and that the total number of press-prints is equal to the total number of rolled prints.
5	If Special Options are used in cases of missing digits, verify "missing" or "not taken" is visible in lieu of a fingerprint in the appropriate blocks of Form FD-258.
6	If there is a problem, direct the FP technician to re-capture the unacceptable fingerprints.
7	Record your six-digit employee number (if QA'd by the ASCM, see note 2 below for what to enter in the "Local AIW Stamp" block) in the AIW "Local AIW Stamp" block.
8	For LIFE Act TENPRINTS record the ASC/COLO site code, your six-digit employee number and the date in the appropriate space on the LIFE Act Processing Stamp. (If QA'd by the ASCM, see note 2 below for what to enter on the LIFE Act Processing Stamp.)
9	Return the applicant's AIW and ID to the FP technician.
10	Direct the FP technician to file the applicant's appointment notification letter in the applicant-processing folder retained at the DBI TENPRINTER workstation.

Notes:

1. QA checks shall be performed in the "Enlarge" screen mode and conducted randomly by selecting "Enlarge" then using the "Up" and "Down" arrows to highlight the desired fingerprint to enlarge. (QA checks will not be random if the monthly average reject rate exceeds 5%. If the site has a monthly average reject rate of 5% or greater, QA checks in the "Enlarge" screen mode will be conducted on 100% of the individual fingerprints.) After the desired fingerprint is highlighted, depress the "Yes" button on the console. After conducting the QA check, press the enter key to exit.

2. The ASCM should use the Site "X Code" and m1 (Manager), m2 (Assistant ASCM) or mt (detailed or temporary ASCM) as their employee/tech ID number. For example- the ASCM at Brooklyn would be XNIm1; the Assistant would be XNIm2; and a CIS Officer detailed into the Site to cover the absence of the ASCM would be XNImt.