**Supplemental Appendix II**

This supplemental appendix provides greater detail regarding the determination of the region of friction ridge skin which maximizes the opportunities of observing higher similarity statistic values (i.e. which region of friction ridge skin results in more similar configurations of features). Two sets of fingerprints were selected to empirically determine the optimal region for conditioning the non-mated distribution: (1) a sample representing the "delta" region of fingerprints and (2) a sample representing the "core" region of fingerprints. Only the delta and core regions were considered because they provide a known anatomical reference point on the fingerprint and have the highest densities of features with respect to other areas of the friction ridge skin. Each dataset was separated into eleven separate subsets, each containing approximately 100 samples, conditioned on the number of features ($n$) being compared (ranging from 5 features to 15 features). All fingerprint images consisted of reference impressions taken under controlled conditions such that distortions were minimized. Features were manually annotated by practicing fingerprint experts. Features were annotated such that the features closest to the reference point (core or delta depending on the sample) were annotated first and then the remaining $n$ features were annotated in a radiating fashion outward. Post annotation, each image was cropped by a bounding rectangle such that only those ridges and features that are part of the annotated configuration remain. These images serve as the "query" print (image #1).

Each query print was then searched using an Automated Fingerprint Identification System (AFIS) against an operational database containing approximately 100 million different fingerprint impressions from approximately 10 million different individuals. The AFIS ranked the top 20 most similar reference fingerprints to the fingerprint image searched. Of the top 20 results, the fingerprint image in rank 1 was confirmed to be a non-mated source with respect to the query print and saved (image #2). For each non-mated rank 1 result, fingerprint features were annotated manually by practicing fingerprint experts and independent of the features annotated on image #1. Features were annotated such that the features closest to the reference point (core or delta depending on the sample) were annotated first then the remaining $m$ features were annotated in a radiating fashion (where $m \geq n + 5$). Fingerprints contain only one core, but some fingerprints, depending on the pattern type, may contain up to two deltas. For the sample consisting of two deltas, the AFIS did not indicate which delta resulted in the high similarity ranking. As a result, for the AFIS results which contained two deltas, both were annotated and the query print (image #1) was compared separately against each delta using the method described in Section I. Between the two possible deltas, the delta resulting in the highest similarity statistic value when compared to the query print (image #1) was retained.

Figure SAII-1 illustrates the empirical cumulative frequency distributions of the similarity statistics between the two samples (core vs. delta). Visually, it can be observed that the distribution of similarity statistic values from the delta region consistently resulted in higher similarity statistic values compared to the core region. A two sample Kolmogorov-Smirnov (K-S) test was performed comparing the distributions for each quantity of features. Table SAII-1 provides the K-S test statistics as well as the resulting $p$-value under the null hypothesis that the two samples originated from the same distribution. Based on these findings, the delta region was determined to maximize the opportunities of observing *higher* similarity statistic values among

non-mated samples and thus is the optimal region of the fingerprint to condition the empirical distribution of similarity statistic values.

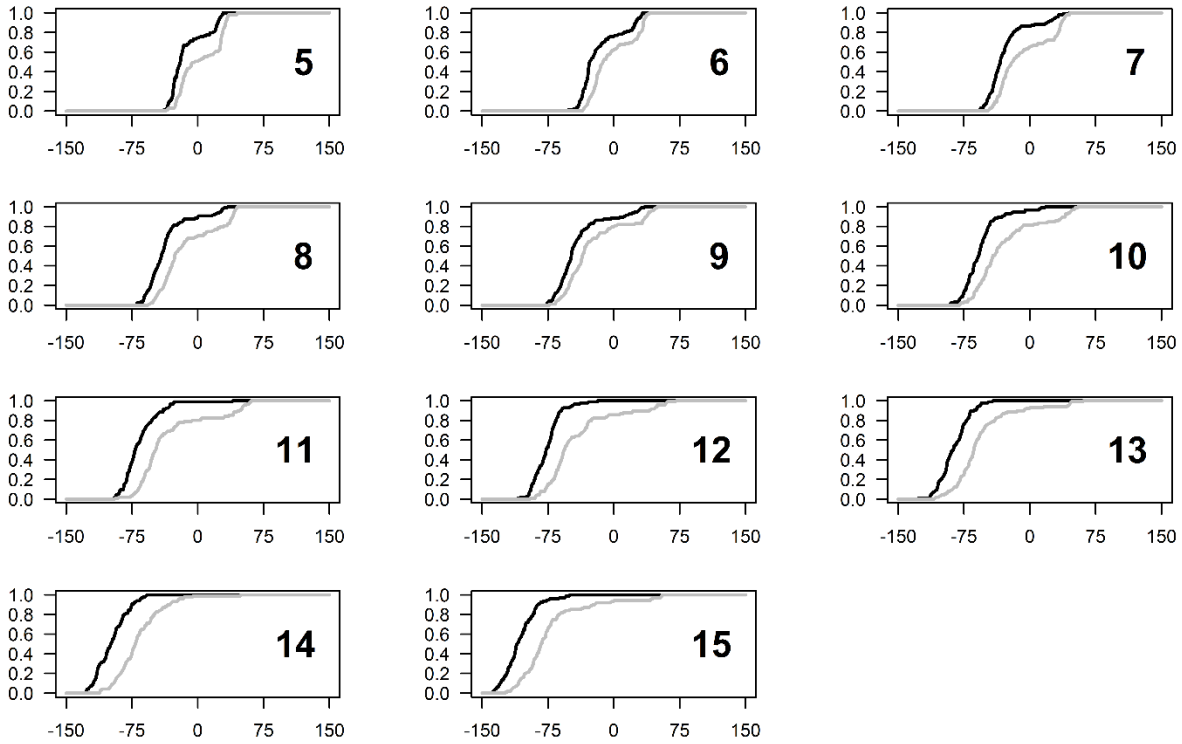


*Figure SAII-1. Empirical cumulative frequency distributions of the similarity statistic values from non-mated AFIS "core" comparisons compared to the non-mated AFIS "delta" comparisons for each quantity of features (ranging from 5 to 15). The black line represents the "core" results. The grey line represents the "delta" results. The X-axis represents the global similarity statistic values.*

| **Feature Quantity** | ***n* sample 1** (core) | ***n* sample 2** (delta) | **K-S test statistic** | ***p (null)*** |
|---|---|---|---|---|
| 5 | 94 | 99 | 0.345 | $p << 0.01$ |
| 6 | 96 | 99 | 0.370 | $p << 0.01$ |
| 7 | 95 | 96 | 0.318 | $p << 0.01$ |
| 8 | 96 | 99 | 0.416 | $p << 0.01$ |
| 9 | 95 | 99 | 0.310 | $p << 0.01$ |
| 10 | 96 | 97 | 0.431 | $p << 0.01$ |
| 11 | 95 | 96 | 0.487 | $p << 0.01$ |
| 12 | 97 | 98 | 0.549 | $p << 0.01$ |
| 13 | 97 | 99 | 0.520 | $p << 0.01$ |
| 14 | 96 | 100 | 0.552 | $p << 0.01$ |
| 15 | 95 | 100 | 0.537 | $p << 0.01$ |

*Table SAII-1. Summary of the Kolmogorov-Smirnov test results between the empirical cumulative frequency distributions of the similarity statistic values from AFIS "core" comparisons compared to the AFIS "delta" comparisons for each quantity of features (ranging from 5 to 15). Although each set initially consisted of 100 samples, some failed search results caused a few images to be discarded prior to calculating the similarity statistic values. Statistical significance is based on a p-value decision threshold of 0.01.*