E58 Score-Based Likelihood Ratio

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After attending this presentation, attendees will better understand score-based likelihood ratio, what it is, how to compute it, factors affecting its computation, and when and how it may be used.

This presentation will impact the forensic science community by advancing quantitative methods for assessing the weight of fingermark evidence. This presentation discusses important details that shall be considered when computing score-based likelihood ratios and provides empirical data on repeatability and reproducibly of different methods for computation of score-based likelihood ratios.

Friction ridge patterns of fingerprints exhibit vast information and are the most widely used forensic evidence for solving crimes. During the analysis, fingerprint examiners visually compare the latent marks from a crime scene with one of the retrieved candidate fingerprints from a database, or compare the latent marks with the prints from a known source. Methods to quantify the weight of evidence are useful in assisting fingerprint examiners with reaching correct conclusions with a higher confidence.

Likelihood Ratio (LR) provides one the of commonly used quantitative approaches to weigh the evidence, which, combined with prior belief, provides the posterior odds of determining the same source versus different sources. Two of the most commonly used LRs are feature-based LR and score-based LR. Whether and how to use these LRs has generated great interest in the forensic community. Feature-based LR relies on large dimensional fingerprint features and has been studied more widely than the score-based LR. The methods for computing feature-based LR are complex, difficult to interpret, and are not readily interoperable because of its dependence on accurate extraction of features and types of features. Score-based LR relies on estimating the distribution of comparison scores from fingerprint comparison algorithms and has recently brought attention to forensic scientists. Score-based LR is considerably simpler to compute because the comparison scores are one-dimensional. Moreover, it borrows strength from repeatability and reproducibility of comparison algorithms which are becoming more accurate. Computing score-based LR values require estimation of the comparison score distribution functions for mated and non-mated groups from a well-established database using an accurate fingerprint recognition algorithm.

This presentation first briefly explores the difference between feature-based and score-based LRs, explains both LRs mathematically and visually, and explains how the LRs are related to the population parameters, such as the population mean and population variabilities. This is followed by a detailed discussion on the calculation of score-based LR using parametric methods and non-parametric methods, namely kernel density estimation and logistic regression estimation. This presentation then discusses their performance as well as their repeatability and reproducibility by comparing score-based LR values generated by those methods using various sample size ratios, various total sample sizes, and various probability distributions.

This study reveals that values of score-based LR depend on sample size and the ratio of mated to non-mated groups. Furthermore, it highlights the importance of careful consideration on selecting an appropriate dataset both in terms of size and representativeness of the background information of the particular forensic case.

This study was performed using operational and laboratory-collected fingerprints and fingermarks. Mated and non-mated comparison scores were generated using automated recognition algorithms. Results are reported separately for each dataset and recognition algorithm.

Score-Based Likelihood Ratio, Repeatability, Reproducibility

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