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Title: A Method for the Statistical Interpretation of Friction Ridge Skin Impression Evidence: Method Development and Validation

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ACCEPTED MANUSCRIPT

A Method for the Statistical Interpretation of Friction Ridge Skin Impression Evidence: Method Development and Validation

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Highlights

- A method is proposed to assess the statistical strength of fingerprint evidence
- The performance was evaluated using a variety of mated and non-mated datasets
- The results show strong performance characteristics with high specificity rates
- The method allows experts to provide an empirical foundation to fingerprint evidence

Abstract

The forensic fingerprint community has faced increasing amounts of criticism by scientific and legal commentators, challenging the validity and reliability of fingerprint evidence due to the lack of an empirically demonstrable basis to evaluate and report the strength of the evidence in a given case. This paper presents a method, developed as a stand-alone software application, *FRStat*, which provides a statistical assessment of the strength of fingerprint evidence. The performance was evaluated using a variety of mated and non-mated datasets. The results show strong performance characteristics, often with values supporting specificity rates greater than 99%. This method provides fingerprint experts the capability to demonstrate the validity and reliability of fingerprint evidence in a given case and report the findings in a more transparent and standardized fashion with clearly defined criteria for conclusions and known error rate information thereby responding to concerns raised by the scientific and legal communities.

Keywords: Forensic Science; Fingerprints; Strength of evidence; Weight of Evidence; Likelihood Ratio; Probability

Introduction

Over the last several years, the forensic science community has faced increasing amounts of criticism by scientific and legal commentators, challenging the validity and reliability of many forensic examination methods that rely on subjective interpretations by forensic practitioners [1-7]. Of particular concern, noted in 2009 by the National Research Council (NRC) of the National Academies of Science (NAS) [3] as well as the President's Council of Advisors on Science and Technology (PCAST) as recently as September 2016 [7], is the lack of an empirically demonstrable basis to substantiate conclusions from pattern evidence, thus limiting the ability for the judiciary to reasonably understand the reliability of the expert's testimony for the given case. Consistent with several academic commentators, both the NRC and PCAST strongly encouraged the forensic science community to develop tools to evaluate and report the strength of forensic evidence using validated statistical methods [3, 7-8]. While these concerns apply to nearly every pattern evidence discipline, the forensic fingerprint discipline has received

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