B115 Reporting Error Rate for Firearm and Tool Mark Identifications in Forensic Science

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After attending this presentation, attendees will appreciate the challenges of conducting evidence-based research to establish a scientific procedure for quantitative error rate reporting to support ballistics and tool mark identifications in the United States.

This presentation will impact the forensic science community by explaining a new method, Congruent Matching Cells (CMC), developed for accurate ballistics identification and error rate calculation.

Side-by-side image comparisons for ballistic identification have more than a 100-year history; however, as stated in a 2008 National Research Council Report: (1) "The validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks [sic] has not yet been fully demonstrated."; (2) "Recent court decisions in which admissibility of firearms toolmark [sic] evidence was in question have generally accepted that the field has validity but have refused to accept 'exclusion of all other firearms' arguments."; and, (3) "Since the basis of all forensic identification is probability theory, examiners can never really assert a conclusion of 'identification to exclusion of all others in the world,' but at best can only assert a very small probability of a coincidental match".[1-2]

However, for DNA-based identifications, the 2009 National Academy of Sciences Report, *Strengthening Forensic Science in the United States: A Path Forward*, stated: "The courts already have proven their ability to deal with some degree of uncertainty in individualizations (with its small, but nonzero, error rate)".[3]

It has been a fundamental challenge in forensic science to conduct evidence-based research for establishing a scientific procedure for quantitative error-rate reporting to support ballistics and tool mark identifications in the United States.

The National Institute of Standards and Technology's (NIST's) Forensic Topography and Surface Metrology Project seeks to support United States forensic identifications by developing novel physical standards and measurement systems. The research team has developed NIST Standard Reference Material (SRM) bullets and cartridge cases which are being used in the United States and foreign crime laboratories as reference standards.[4,5] The team also developed topography measurement systems and correlation software for bullets and cartridge cases, which have been used in support of the 2008 National Academies Study and in a laboratory comparison of ballistic imaging systems in crime labs.[4,6,]7 In addition, results of two studies have shown a high-correlation accuracy using the NIST topography correlation system relative to a commercial system.[6,8]

NIST researchers have recently developed the new CMC method for accurate ballistics identification and error-rate calculation. The CMC method is based on correlations of pairs of small correlation cells instead of correlations on the entire images. Three types of identification parameters are created for uniquely identifying correlated cell pairs originating from the same firearm. This enables an approach to calculating error rates based on the total number of correlation cells, the number of qualified CMC cell pairs, and the false positive and false negative identification probability for an individual cell pair. Validation tests of the CMC method have recently been completed using 40 cartridge cases fired with consecutively manufactured pistol slides. These tests include 717 Known Non-Matching and 63 Known Matching image correlations. The results do not produce any false positive or false negative identifications and so provide strong initial support for the effectiveness of the CMC method. A method for calculating error rates has also been developed using the CMC approach. It is believed that this method can be adapted to large databases and used for supporting ballistics identifications in court proceedings in a manner similar to methods used for DNA identifications.

References:

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