B117 Improved Congruent Matching Cells (CMC) Method for Optical Images Identification of Cartridge Cases

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After attending this presentation, attendees will understand a new theory of ballistics identification, the implementation of this method, and the applications on cartridge case identifications.

This presentation will impact the forensic science community by applying the proposed CMC method to cartridge case identification. The method can decrease the effect from "invalid areas" of images and improve the accuracy of identification.

The CMC method was invented by the National Institute of Standards and Technology (NIST) with the ultimate goal of providing objective and high-accuracy ballistics identifications and evidence searches. The CMC method is based on the correlation of pairs of small correlation cells instead of correlation on entire images to identify the "valid correlation areas" and eliminate the "invalid correlation areas." Four identification parameters are proposed for uniquely identifying correlated cell pairs originating from the same firearm. The correlation conclusion (matching or non-matching) is determined by the qualified CMC numbers $C \geq 6$.[1] This method has already been validated by a set of 780 pair-wise 3D topography images captured on 40 cartridge cases fired from handguns with ten consecutively manufactured pistol slides; however, most ballistics images stored in current national databases are optical intensity format.[2] As a result, the reliability of applying the CMC method on optical intensity images is an important issue.

To verify the effectiveness of the CMC method on the optical images, this presentation initially introduces the implementation of the CMC method and provides a fast correlation method and the strategy for threshold determination. Then the optical intensity images captured on the same set of 40 cartridge cases under the top-ring lighting source (which provides uniform light conditions) are correlated and analyzed. This includes 780 correlations of 63 pairs of matching images and 717 pairs of non-matching images. The tests of the method do not produce any false identification (false positive) or false exclusion (false negative) results, which supports the CMC method and the identification criterion $C=6$ for firearm identifications using optical intensity images. To improve the identification accuracy of the CMC method, a new method has been developed to process cell correlations at each rotation angle and combine the forward and backward comparisons to improve the identification accuracy. In the initial test, the CMC method identifies all of 780 correlations correctly. Compared with the result of the original method, the improved result shows a larger gap between the matching and non-matching correlations, which proved that the improved CMC method is effective in improving the accuracy of identification. Based on results of the study, it is considered that the principle of the CMC method is effective in firearms identifications in both 3D topography images and optical images of cartridge cases. The proposed identification criterion $C=6$ is also working well in current experiments.

References:

1. J. Song, Proposed NIST Ballistics Identification System (NBIS) Using 3D Topography Measurements on Correlation Cells, *AFTE Journal*, 45, 2, 2013, p184-194.
2. W. Chu, M. Tong and J. Song, Validation Tests for the Congruent Matching Cells (CMC) Method Using Cartridge Cases Fired with Consecutively Manufactured Pistol Slides, *AFTE Journal*, 45, 4, 2013, p361-366.

Ballistics Identification, Cartridge Case, Congruent Matching Cells (CMC)