A165 Automatic Identification of Bullet Signatures Based on Consecutive Matching Striae (CMS) Criteria

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The goal of this presentation is to introduce a basic model and procedure to process the bullet topography and count the consecutively matching striae in an automated identification system

This presentation will impact the forensic scientific community by showing how this research makes the computerized database search system capable of completely implementing the identification task rather than simply giving a priority order for further manual operations.

Although the forensic science specialty of firearm and tool mark identification in criminal investigation has more than a century of history, it has been challenged over the years for its subjectivity and its difficulty to articulate how identification is made. In 1997, Biasotti and Murdock published their quantitative criteria for identification as expressed in terms of Consecutively Matching Striae (CMS). Since the CMS criteria were established by empirical studies using manual operations and observation, determining the maximum number of well-defined matching striae in a large statistical sample of Known Non-Matches (KNM) was a practical impossibility. Automated systems are expected to go a long way toward establishing objective quantitative criteria and a statistical foundation for identification since they can quickly perform a large number of comparisons. The CMS criteria can then be validated or revised accordingly. These automated measurements, which are more objective, can therefore be used to increase confidence in the validity of the CMS approach originally developed and practiced using direct manual comparisons.

With previous experience in automated bullet identification research, National Institute of Standards and Technology (NIST) tries to address the questions about statistics and subjectivity and to provide a method for automation of CMS as the similarity metric. A computerized identification method based on 3D topography measurement and CMS criteria was developed. The position and shape information of the striae on the bullet land is represented by a feature profile, which is used for determining the CMS number automatically. CMS values are automatically calculated from surface topography images for a set of unknown bullets compared to a set of knowns. The set of test bullets were fired from ten consecutively rifled 9mm pistol barrels. The known matching set consists of 10 pairs of bullets and 60 matching land comparisons. Using the developed algorithm, all 10 pairs of bullets fired from the same gun barrel were successfully identified. Then the model was applied to the 15 ‘‘unknown’’ bullets. Before these experiments, the operator did not obtain any barrel source information about these bullets and, therefore, this phase of the testing was ‘‘blind.’’ Each of these 15 unknown bullets should match the two bullets in the control set that were fired from the same barrel. Out of a total of 30 matching pairs, 29 were correctly identified. These tests for the known matching and known non-matching bullets demonstrated the validity of the model. It makes the computerized database search system capable of completely implementing the identification task rather than simply giving a priority order for further manual operations. It increases the objectivity of firearm identification examination. Also, the model lays solid groundwork for future statistical analysis. Even though the database used in this study was limited and was obtained from a specified type of firearm, it is practical to extend the method to a large database.

Bullet, Identification, Consecutive Matching Striae

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