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ИДЕНТИФИКАЦИЯ ПО СЛЕДАМ НА ГИЛЬЗАХ С ИСПОЛЬЗОВАНИЕМ ТОПОГРАФИЧЕСКИХ ИЗМЕРЕНИЙ МИКРОНЕОДНОРОДНОСТЕЙ И КОРРЕЛЯЦИИ. ОБЪЕДИНЕНИЕ МИКРОСКОПИИ И СТАТИСТИЧЕСКИХ МЕТОДОВ

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Для корректной идентификации оружия по следам от 10 последовательно изготовленных пистолетных затворов в работе применялся сравнительный микроскоп, использующий стандартный оптический метод сравнения и конфокальную микроскопию с возможностью проведения топографического кросс-корреляционного анализа. Идентификации были основаны на математических расчетах изображения следов от патронного упора без учета следа бойка. Пятнадцать неизвестных гильз были сравнены с набором гильз, выстреленных из оружия с последовательно произведенными затворами.

Ключевые слова: криминалистика, гильза, баллистическая идентификация, справочные материалы (СМ), стандартизованная гильза, конфокальный микроскоп с диском Нипкова.

Cartridge Case Signature Identification Using Topography Measurements and Correlations. Unification of Microscopy and Objective Statistical Methods

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A comparison microscope employing the standard optical comparison method and confocal microscopy with subsequent cross correlation topography analysis were used to correctly identify cases fired from a set of ten (10) consecutively made pistol slides. The mathematical identifications were based on the breech face impression without the firing pin aperture shear marks. Fifteen (15) unknown cartridge cases were compared to test fired cartridge case sets from the consecutively manufactured slides.

Key words: forensic science, cartridge case, ballistics identification, standard reference material (SRM), standard cartridge case, a Nipkow disc confocal microscope.

Brief Methodology

Cartridge cases that comprised test fires from ten (10) consecutively manufactured Ruger slides, fifteen (15) unknown cases, and five (5) «persistence study» cases were received from Thomas Fadul from the Miami Dade Crime Laboratory. The cases were microscopically examined and the results were later confirmed as accurately associating all of the questioned cases back to the correct pistol slide sources. These results were not communicated to the project team until after the surface metrology and correlations were completed.

A Nipkow disc confocal microscope was used to gather the 3D topography data from the breech face area of each case. The data were then trimmed to remove any uninformative areas. Preprocessing software then was employed to identify outlier and dropout points, which are typical artifacts in this type of surface measurement. These outliers and dropouts were then interpolated and masked from further correlations. Next, the software applied a Gaussian filter to the data to remove long wavelength waviness and short wavelength noise. After the filter, the data were then leveled and were registered in the *X, Y* and *u* directions to locate the maximum correlation position. After the registration was completed, the software applied the cross correlation algorithm to quantify the similarity between two cases.

A total of 1600 correlations were performed in a 40 x 40 matrix. Using statistical analysis from the known match and known non-match correlations, a baseline cross correlation function *(CCF)* was established to identify matches. Finally, the results of the mathematical determination of slide source were compared to the validated results from the microscopic comparisons.

Summary of Results

Based on the *CCF* results, and a statistical analysis of the match and non-match case scores, 19 of the 20 unknown cases were correctly identified to the slides that they came from. One case was not positively identified back to its original slide and had an «inconclusive» scoring. However, this one case was identified to other unknown cases that were correctly identified to the same slide.

General Conclusions

Using the topography from the breech face portion of the cartridge case, the cross correlation function performed very well in identifying the unknown cases back to their slides. These results provide an objective mathematical validation of consecutive pistol slide breechface identifications that is in harmony with the results of optical comparison microscopy employed by an experienced firearms examiner.