A195 The Examination, Evaluation, and Identification of Fired 9mm Cartridge Cases Fired from 1,500+ Different GLOCK® 9mm Semiautomatic Pistols Manufactured Over a 20-Year Period

James E. Hamby, PhD, Int'l Forensic Science Lab, 410 Crosby Dr, Indianapolis, IN 46227; and Steven A. Norris, BS, 208 S College, Cheyenne, WY 82002*

After attending this presentation, attendees will understand some principals of utilizing both optical, confocal microscopy and computational pattern recognition in the examination and identification of fired GLOCK® 9mm cartridge cases to include fired cases that were obtained from recently manufactured consecutive firearms slides.

This presentation will impact the forensic science community by demonstrating the ability to identify fired cartridge cases to specific firearms.

Over the last several decades, forensic examiners have struggled with the fact that there is no accepted methodology to generate numerical proof that would independently corroborate morphological conclusions regarding impression evidence such as tool marks. The purpose of this research is to take a step toward developing standardized methodologies that can objectively evaluate tool markcomparison and identification. This presentation will impact the forensic and legal community by presenting the results of research conducted over a 20-year period that involved the identification and inter comparison of over 1,500 fired cartridge cases.

In this research, 617 GLOCK® Model 17 & 19 9mm semiautomatic pistols were obtained from the then Indianapolis Police Department (IPD) and test fired to obtain four fired cases from each pistol. The test fired cases were microscopically examined, evaluated, and intercompared using forensic optical comparison microscopy to determine if the casings could be individualized. Subsequentially, 700 additional cartridge cases—recently manufactured over a five-year period—were added to the research. Using forensic optical comparison microscopy, the combined 1,275 test fired cases were microscopically examined, evaluated, and compared if the fired cases could be individualized. A report of this research experiment was presented at the 2011 annual training seminar of the Association of Firearm and Tool Mark Examiner (AFTE). An additional 225+ fired cases have been added to the existing research cases and examined to determine if they are identifiable to themselves and to the exclusion of the other cases.

Additionally, this research is to take a step toward developing standardized methodologies that can objectively evaluate tool markcomparison and identification. Fifty-eight primer shear marks on 9mm cartridge cases, fired from four GLOCK® Model 19 pistols, and a series of 9mm cases test fired from recently manufactured consecutive GLOCK slides were collected using high-resolution, white light confocal microscopy. The resulting three-dimensional surface topographies were processed with outlier and form removal before a cubic spline filter was used to extract all "waviness surfaces"—the essential "line" information familiar to firearm and tool mark examiners. Taking the mean of all profiles that made up each surface summarized the primer shear waviness topographies. The mean profiles were then subjected to Principal Component Analysis (PCA) for dimensional reduction and Support Vector Machines (SVM) for profile-gun associations. Using 10,000 bootstrap resampling iterations, PCA-SVM required only six "synthetic" features (6D) to produce an estimated identification error rate of 0% on a larger data set of assumed similar statistical properties. At the 95% level of confidence, Conformal Prediction Theory (CPT) coupled with SVM showed an empirical error rate of 7%, slightly higher than the long run guarantee of 5%. With these results, suggestions are made for practical courtroom application of CPT for assigning levels of confidence for SVM identifications of tool marks recorded with confocal microscopy.

Forensic firearms examiners have routinely identified fired bullets and cartridge cases with suspect firearms over the past 100+ years, including numerous studies involving consecutively manufactured components. Conversely, firearms examiners have routinely excluded fired components (bullets and/or cartridge cases) during this same time period. In this research project, examination of the fired cartridge cases against each other, validated that each was identifiable and unique. Additionally, the utilization of confocal microscopy and computational pattern recognition in examining some of these fired cases—including several from consecutive manufactured slides—further validates the ability of a trained examiner to differentiate between various fired components.

This presentation will impact the forensic and legal communities by demonstrating the ability of qualified examiners to evaluate and inter compare a significant number of fired cartridge cases (over 2,250,000 examinations) using conventional optical microscopy. Additionally, the research to take a step towards developing standardized methodologies that can objectively evaluate tool mark comparison and identification with the addition of confocal microscopy will be of great value to the forensic and legal community.

Firearms ID, Manufacturing, Legal Issues

 ** Presenting Author*