B100 An Experiment to Explore Persistence of Bullet Striations

Heike Hofmann, PhD, Center for Statistics and Applications in Forensics, Ames, IA 50011; Alicia L. Carriquiry, PhD, Center for Statistics and Applications in Forensics, Ames, IA 50011; Nicholas A. Lennie, BSc, Story County Sheriff's Office, Iowa, Nevada, IA 50201*

Learning Overview: After attending this presentation, attendees will better understand study design, 3D imaging, and persistence of bullet striations. Attendees will also learn about new technologies for comparing bullets using 3D images of land impressions.

Impact on the Forensic Science Community: This presentation will impact the forensic community by presenting experimental data that permit exploring the fundamental assumption of repeatability of striations on bullets.

Firearms examination relies on two fundamental assumptions—uniqueness and repeatability. The uniqueness assumption states that every gun leaves a unique pattern of striations on bullets and cartridge cases. The repeatability assumption states that these unique marks do not change over time unless the inside of the barrel of the gun are altered by mechanical or chemical means. If striations are repeatable, it is said that the markings are *persistent.*

To better understand the concept of persistence, researchers in the Center for Statistics and Applications in Forensic Evidence, in collaboration with the Story County Sheriff's Office in the State of Iowa and the Division of Criminal Investigation in Iowa conduced a controlled experiment to collect information useful to explore the question of persistence. The timing for the study was fortuitous, since early in the year the Story County Sheriff's Office decided to switch to Sig Sauers to use as the official firearm for all law enforcement personnel. Consequently, over 20 brand new Sig Sauers P320 pistols were made available to us to conduct the study. Data collection is still ongoing, but the first set of 20,000 test fires has already been collected and imaged. In a second phase of the study, 15 Smith and Wesson pistols confiscated from suspects and provided by the DCI are being used to replicate the study.

Both the bullet and the cartridge case were collected from each test shot included in the study. To collect the samples, guns were fired into a cylindrical steel tube packed with Kevlar fibers and equipped with three side doors to facilitate finding the bullet. As the guns had never been fired, the first 10 test shots were of interest and were kept for imaging. After the first ten shots, the first three bullets and cartridge cases out of every fifty were collected for imaging. Therefore, for each gun the ammunition that was set aside for imaging included shots number 1-10, 50-52, 100-102, 150-152 and so on through 2000-2002. The Sig Sauer P320 magazine holds 17 rounds, so between each set of 3 experiment shots, almost three full magazines were emptied into the berm surrounding the firing range of the Story County Sheriff's Office. Every gun was taken apart and both the inside of the barrel and the breech face were cleaned with gun oil and soft brushes and cloth every 50 shots. Guns had a chance to cool down between being shot 50 consecutive times.

The working hypothesis is that a barrel produces different patterns of striations until it "settles." If so, then bullets 50-52 would be less like bullets 100-102 than bullets 1500-1502 are to 1600-1602. Related questions of interest are: (1) When do the Sig Sauer barrels settle (i.e., when do markings begin to exhibit persistence), (2) What is the variability in terms of time to persistence across similar guns, and (3) What differences will be seen when the shots are from the set of Smith and Wessons with different level of use and care?

In this presentation, only results obtained from the Sig Sauer guns will be discussed. The data for analysis are the 3D images of land impressions, and the comparisons between pairs of bullets are carried out using the algorithms developed by CSAFE researchers in Iowa State University.[1,2] The persistence dataset is a valuable resource for researchers in this area and will be placed in the public domain as soon as possible.

Reference(s):

1. Hare E., Hofmann H., Carriquiry A.: Algorithmic Approaches to Match Degraded Land Impressions., Law, Probability and Risk, accepted, doi:10.1093/lpr/mgx018.
2. Hare E., Hofmann H., Carriquiry A.: Automatic Matching of Bullet Lands., Annals of Applied Statistics, accepted, doi: 10.1214/17-AOAS1080.

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