

Study Compares Gun Barrels and Bullets

Advances in forensic science, especially in DNA analysis, have gained notoriety from the media that has in turn created unrealistic perceptions in the minds of judges and jury members. Their high expectations of accuracy can create problems relating to the use of certain forensic evidence in court, specifically impression evidence. However, a recent study conducted by Intelligent Automation, Inc., using funding from the Office of Justice Programs' National Institute of Justice (NIJ), may help to eliminate some of those problems in the area of firearms evidence.

Dr. Benjamin Bachrach, principal investigator for the project and vice president of the company's Signals Sensors and Systems Division, explains that the project involved assessing the individuality and repeatability of features that transfer between a barrel and a bullet, with the goal of strengthening the scientific foundations of firearms examination in firearms examination results. The extensive project encompassed a three-year time span and involved firing 2,800 bullets using nine different brands of weapon barrels and two different types of ammunition. The project involved collaboration with the Baltimore County (Md.) Police and Washington State Police, as well as the FBI.

"The problem that firearms examiners have been having when testifying in court is that their conclusions are guided by their experience, and are therefore very difficult to quantify," says Bachrach. "By contrast, DNA evidence enjoys the benefit of extensive and well-established statistical validation studies. With the completion of this and related studies, there is now a body of science funded by NIJ that can – at least for barrels of certain quality – help firearms examiners convince a jury of the accuracy of firearms identification."

Bachrach says that although a number of parameters influenced the individuality and repeatability of the results, the manufacturers of the firearm barrel and the bullets were key.

"For certain brands, the transfer of characteristics was very repeatable and the bullets could be identified very well. However, for a group of low-end, relatively

inexpensive products, we could not show repeatability as well," he says.

The results of the study have been published in *Statistical Validation of the Individuality of Guns Using 3D Images of Bullets*, a 66-page report that describes the study as "setting out to improve and make advances on state-of-the-art automated ballistic analysis systems and developing and validating methodologies for ballistic identification."

The report concludes that the study "provides a solid validation of the foundations of ballistic identification," with some limitations noted and explained. The study included three major components:

- An examination of the effect of barrel wear. Results showed that barrel wear did not have a significant impact on the transfer of features between barrels and bullets.
- Development of methodologies that evaluated a barrel's individuality and estimated the probability of error when making bullet-to-barrel classifications. The study focused on the comparison of bullets fired by barrels of the same make and manufacture for eight different barrel brands. The results of the study showed that a classification approach could be applied to identify bullets fired from different barrels.
- Analysis of whether the conclusions of the first two components also applied to damaged bullets. This analysis was significant because bullets recovered as evidence often suffer some degree of damage. Results show that damaged bullets could be linked to a specific barrel with a high degree of certainty in some cases, although not as high as that of pristine bullets. More work remains to be done to improve the classification approach for damaged bullets.

The study also developed and used a 3D-based ballistic analysis system to try to determine:

- The quantitative criteria that should be used to establish a gun's individuality.

- The quantitative criteria that should be used to establish that a specific gun fired a specific bullet.
- Whether it is possible to estimate the probability of a bullet/gun match being incorrect.

Answers to these questions would help law enforcement agencies deal with potential *Daubert* challenges in court (see box). According to the report, “Automated ballistic analysis systems are specifically designed for the objective comparison of large numbers of samples, making them an ideal instrument for the development of objective performance bounds [measures]. The development of such procedures reinforces the scientific foundations of ballistic evidence to be presented in court.”

“This is important because there has been a significant amount of criticism recently regarding the validity of the forensic sciences,” Bachrach says. “Specifically, one of the disciplines that has had question marks posed against it is that of toolmark and firearms examination, and these question marks could make it difficult to present evidence in court.” He adds that dissemination of study results should help convince judges and juries of the validity of this type of analysis as a scientific discipline.

The text of Statistical Validation of the Individuality of Guns Using 3D Images of Bullets may be downloaded from <http://www.ncjrs.gov/App/Publications/abstract.aspx?ID=235176>.

THE DAUBERT STANDARD AND ITS IMPACT ON FORENSIC EVIDENCE

The 1993 U.S. Supreme Court case, *Daubert v. Merrell Dow Pharmaceutical, Inc.*, is considered a landmark ruling related to validity of scientific evidence. The ruling applies only in federal courts, but numerous state courts use it as guidance related to whether to admit scientific evidence. In *Daubert*, the U.S. Supreme Court advocates that trial judges must become “gatekeepers” regarding the reliability and admissibility of scientific evidence. Guidelines provided by the court emphasize that their inquiries should be flexible. Possible areas of inquiry include:

- Can the scientific technique or theory in question be tested, and if so, has it been?
- Has the technique or theory been subject to peer review and publication?
- What is the technique’s potential rate of error?
- Do standards related to the technique exist, and if so, are they kept current?
- Has the technique or theory gained widespread acceptance within the scientific community?

Daubert’s basis comes from civil proceedings, but it has been used to question the validity of forensic science used in criminal proceedings.

Source: Saferstein, Richard. 2001. *Criminalistics: An Introduction to Forensic Science, 7th ed.* Upper Saddle River, NJ: Prentice-Hall, Inc., p. 13.

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