# D16 The National Ballistic Imaging Comparison Projects

*James H. Yen, PhD*, Statisical Engineering Division, NIST, 100 Bureau Drive, Stop 8980, Gaithersburg, MD 20878-8980; Theodore V. Vorburger, PhD, 100 Bureau Drive, Mail Stop 8212, Gaithersburg, MD 20899; Xiaoyu A. Zheng, MS, 100 Bureau Drive, Mail Stop 8212, Gaithersburg, MD 20899; Thomas B. Renegar, BS, 100 Bureau Drive, Mail Stop 8212, Gaithersburg, MD 20899; Junfeng J. Song, MS, 100 Bureau Drive, Stop 8212, Gaithersburg, MD 20899; Johannes A. Soons, PhD, NIST, 100 Bureau Drive, Mailstop 8223, Gaithersburg, MD 20899; Robert M. Thompson, BS, NIST, OLES, 100 Bureau Drive, MS 8102, Gaithersburg, MD 20899; Martin G. Ols, BS, Bureau of Alcohol, Tobacco, Firearms, and Explosives, Ammendale, MD 20705; and Wei Chu, 100 Bureau Drive, Mail Stop 8212, Gaithersburg, MD*

After attending this presentation, attendees will learn: (1) how the use of reference materials; (2) control charts and limits; and, (3) attendant statistical analyses that characterize the variability of measurement processes involved in image acquisition for some ballistic identification systems.

This presentation will impact the forensic science community by presenting case studies of how measurement quality studies using reference materials helped to maintain and improve the measurement process in ballistic laboratories.

When evidence bullets or casings are found at a crime scene in the United States, the National Integrated Ballistics Information Network (NIBIN) can be searched to find the bullets or casings most similar to the evidence bullet or casing that has been previously entered into the database. Spent casings usually have three areas that contain tool mark signatures left by the following parts of a firearm: the firing pin, breech face, and ejector. The surface of a fired bullet often contains Land Engraved Areas (LEAs) that are tool marks engraved (scraped) on the bullet by the rifling inside a gun barrel. Images of these important areas are acquired and entered into the NIBIN system. Comparisons with ballistic impressions from known firearms and evidence already in the database are carried out utilizing a proprietary similarity or "correlation" score between the relevant images.

The value of such ballistic database searches is dependent on the quality of the measurement and imaging process. The National Institute of Standards and Technology (NIST) has developed a standard bullet (NIST SRM 2460) and a standard casing (NIST SRM 2461) to help forensic laboratories maintain and improve their measurement procedures. The standard bullets and casings are manufactured to resemble tool marks found on actual bullets and casings and have been certified to be almost identical to a reference standard bullet and casing, respectively. The surface of the standard casing contains electroformed marks that replicate signatures impressed by a firing pin, breech face, and ejector. The surface standard bullet contains marks that are diamond-turned replicates of six different LEAs.

The first National Ballistics Imaging Comparisons (NBIC-1) project involved a select group of volunteer operators of NIBIN instruments from across the country. Each was given access to a standard bullet and a standard casing and instructed to perform a series of periodic image acquisitions of their bullet and casing. The goal was to characterize what would be the typical values and variation of the correlation scores of their acquired images as compared to "Golden Images" of the same areas of the standard bullet and the standard casing that had been previously entered into the NIBIN system. The NBIC effort was not meant to be a survey of then-current operator practice. Rather, it was intended to be both diagnostic and exploratory, with the ultimate goal being a baseline of best practices, formalized by control limits, with control charts for monitoring individual performance. Thus, the fruits of NBIC-1 included not only control limits for each ballistic area measured (based on data from the operators), but also some improvements in the performances of operators, the system, and the standard casings.

In the last few years, the image-acquisition instruments for casings used in NIBIN are being replaced by a newer version of the instrument that, among other things, automates part of the image-acquisition process. The second National Ballistics Imaging Comparisons project, NBIC-2, involved another group of NIBIN operators performing image acquisition of the standard casing on the newer instruments. The goal is to characterize and compare the ensuing typical values and variation of correlation scores, including revised control limit values. In addition, some insight into differences between the two systems and their respective "Golden Images" is obtained.

**NIBIN, Firearm, Ballistic Identification**

 ** Presenting Author*