IBIS BULLETTRAX-3D: The Only System to Automatically Image & Compare 3D images of Fired Bullets

IBIS® BULLETTRAX-3D™ is the only 3D/2D imaging system on the market capable of automated imaging, comparison, enhanced visualization and analysis of fired bullets that have sustained damage and/or fragmentation.

Some producers of ballistics technologies claim that their systems are "3D-capable", however the 3D imaging techniques they employ are limited to enhanced image viewing and are not able to perform automated imaging and image comparison as performed by BULLETTRAX-3D.

Compared to 2D, 3D automated imaging and comparison of fired bullets requires a different approach that is dependent on two crucial factors:

1. Sufficient depth and lateral resolution in order to collect very detailed data from tiny topographical peaks and valleys on the fired bullet.

2. Sufficient rotational & lateral control of the bullet in order to capture accurate and undistorted data from its irregular (damaged) shape and surface area.

Capturing Incredible Detail

Achieving a sufficient depth and lateral resolution for automated comparison is challenging because the majority of striated marks on a bullet's surface are less than one micron deep and fifteen microns wide. Therefore, detailed and accurate data must be collected in order for the system to automatically compare these minute markings in an accurate manner. To meet the challenges of automated imaging and comparison of fired bullets, the BULLETTRAX-3D technology is capable of achieving depth resolution at the sub-micron level (e.g. ~200 nanometers) and lateral resolution at the three micron level.

Distortion-Free Orientation

In addition to the achievement of proper depth and lateral resolutions, a practical crime-solving solution also demands the ability to process damaged bullets and fragments.

Often, bullets fired during the course of a crime sustain significant damage and deformation as they strike various objects. If a ballistics system cannot image and process damaged bullets and fragments then it is not a practical crime-solving solution.

The challenge for any automated system is to keep the bullet in the correct orientation as it moves through the data collection cycle around and across what is most often an irregularly shaped surface area. In order to capture an accurate and non-distorted image, the area of topographical interest to be imaged must remain perpendicular to the sensor.

BULLETTRAX-3D is the only system on the market to provide a five-axis automated imaging stage capable of rotational and lateral movement. BULLETTRAX-3D provides high resolution 3D and 2D images of the bullets topography which are free of distortion (e.g. false repetition of marks) regardless of bullet or fragment shape.

Conclusion

When comparing 3D-capable ballistics systems that claim to perform the automated comparison of fired bullets, look for the following:

Automated Comparison – Is the depth and lateral resolution data collected at the sub-micron and micron level? If not, critical data will be lost in the 3D images thus adding no value to the automated comparison process.

Automated Imaging – Is a five-axis stage for rotational and lateral control of the bullet used to accurately capture data from damaged bullets and fragments? If not, systems providing only rotational control will cause easily recognizable image distortion particularly when working with the flat surface areas of a bullet or fragment.

Forensic Technology believes that for automated bullet imaging and comparison, 3D imaging combined with 2D imaging is the best solution. By combining 3D and 2D correlation scores we have observed a 25% increase in matching accuracy with both lead and copper bullets.

IBIS BRASSTRAX-3D: A Unique 3D System for Imaging & Comparing Fired Cartridge Casings

IBIS® BRASSTRAX-3D™ is the only 3D/2D imaging system on the market capable of automated imaging, comparison, enhanced visualization and analysis of fired cartridge casings that integrates all of the following advantages:

- Field-proven and time-tested comparison algorithms.
- Orientation-independent annular lighting.
- Specialized algorithms for imaging and comparing ejector and rim fire marks.
- Reverse 3D visualization of the primer.
- Wide field of view for imaging the entire primer area.

Field-proven and time-tested comparison algorithms that produce highly accurate results across large database networks

In 2008, after a four-year study, the National Research Council of the National Academies (NRCNA) of Science issued a report on ballistic imaging technology. The council studied the IBIS comparison algorithms in great detail and concluded: "It is our judgment that the algorithm is generally quite sound, novel, and appropriate to the task of comparing images of ballistic evidence." For 17 years, IBIS users in over 45 countries have relied upon these algorithms. Globally, IBIS users have imaged an estimated 2 million exhibits linking over 100,000 shooting incidents to generate leads that could not be obtained by other means.

Orientation-independent annular lighting eliminates operator variability during imaging and also removes the need for expert technical input

Other types of lighting – which are orientation dependant – yield images that are sensitive to the orientation of the cartridge case when the image is captured. BRASSTRAX-3D lighting is much more robust and less prone to user error. By using orientation-independent lighting, a cartridge case that is improperly oriented during acquisition will not pollute the database and become a worthless exhibit.

Specialized algorithms allow for the imaging and comparison of ejector and rim fire marks

BRASSTRAX-3D employs a series of algorithms developed specifically for breech face, firing pin, and ejector mark / rim fire impressions. The ejector mark is one of the most relied upon marks for linking cartridge casings fired from assault type weapons, such as 7.62x39 mm, Kalashnikov-type rifles – commonly used by criminal gangs and terrorists. Also, since breech face, firing pin and ejector marks correlate independently, adding the ejector mark image can significantly improve the system's correlation accuracy.

Reverse 3D visualization of the primer which provides the ability to see the firing pin shape - generally hidden from view

Traditional methods of cartridge case examination with a comparison microscope as well as with other 2D imaging systems cannot reveal the shape of a firing pin because they cannot provide a three-dimensional perspective nor can they collect the required 3D data that BRASSTRAX-3D can provide.

Wide field of view for imaging the entire primer area eliminates errors associated with the "stitching" of Depth from Focus (DFF) images

The stitching of partial images together to make a whole is difficult to do using DFF imaging techniques with current commercial ballistic systems. The relatively low-depth resolution at the outer boundaries of the images used in constructing the mosaic is prone to discontinuities along the vertical axis. These discontinuities would be apparent in the 3D view as artifacts or false features; however BRASSTRAX-3D does not depend on DFF stitching since it employs a wide field of view.

Conclusion

BRASSTRAX-3D is a cartridge case acquisition station that captures highly-detailed images of cartridge cases in both two and three dimensions – offering considerable impression detail and multiple viewing perspectives. The high level of automation, coupled with the modular architecture is particularly valuable in that it facilitates the design of new and innovative work processes, extends the reach and range of the technology, redirects workloads, and helps reduce case backlogs.

