SHOOTING INCIDENTS REPRESENT A PROBLEM THAT HAS GROWN throughout the United States for years, and persists at a concerning level. Officer-involved shootings have been a particular focus over the past several years due to greater public pressure and the increased frequency of having these incidents caught on video. In 2015, The Bureau of Justice Statistics released a report that estimated the number of justifiable homicides in the United States between 2003-11 (excluding 2010) was 7,427, or an average of 928 law enforcement homicides per year. The situations that prompt officer-involved shootings vary widely. According to The Washington Post, in an analysis of 385 fatal police shootings in the first five months of 2015, about half of the time police were responding to people seeking help with domestic disturbances and other complex social situations: erratic behavior, people threatening violence, others attempting to kill themselves. The other half of shootings involved non-domestic crimes, according to the newspaper.

Investigators strive to accurately document every shooting scene, but when an officer-involved shooting occurs, there is often greater pressure and scrutiny involved in the case. In today’s world of endless internet news and social media coverage, every officer-involved shooting can quickly become a high-profile case. Recent high-profile shooting incidents, such as the 2014 death of Michael Brown in Ferguson, Missouri, can easily lead us to assume that any time an officer uses a gun, the story will be instantly scrutinized by the media and the general public.
These scenes can be among the most difficult crime scenes to investigate due to the variety of evidence that may be spread over a large area. Shootings may occur inside buildings or on streets, may contain a huge amount of physical evidence, and may even involve cars fleeing the scene. Although the actual shooting itself may be confined to a relatively small area, the movements of the suspect and police may cover a much larger expanse, all of which must be properly documented.

When investigating and documenting officer-involved shooting scenes, time is precious. “We’re always dealing with perishable evidence in time, and also available resources,” said Deputy Scott Wells, a 19-year veteran with Snohomish County (Washington) Sheriff’s Office, who has investigated 40 officer-involved shooting cases. Evidence that can be immediately captured from these scenes—blood, bullet casings, and witness observations—is pivotal to understanding how events may have unfolded. Wells observed the public perception that there is an uptick in officer-involved shootings. However, data collection on these incidents has also been inconsistent.

3D Technologies Used More Widely for Shooting Scenes

Over the past decade, a new trend in crime scene investigation is the adoption of 3D laser scanners to accurately measure the position, size, and orientation of evidence at shooting scenes. Laser scanners are able to collect vastly larger amounts of information from a scene in less time than other mapping tools. More importantly, a laser scanner can capture and “freeze” the scene as-is, which is critical should a case head to court. With a scanned scene, “You’re going to walk in (to a courtroom) with much more data than ever before, and you’re collecting evidence you don’t even have to think about,” said Mike Haag, a veteran forensic scientist and laser scanning trainer with Forensic Science Consultants in Albuquerque, New Mexico. “You have the entire scene captured, and you can come back to it over and over again.”

Scanner Aids Forensic Techniques

By allowing investigators to capture crime scenes in their entirety, in 3D, the laser scanner provides an exact record of the entire scene by creating an XYZ point cloud that looks like a photograph and consists of millions of data points, each with its own unique XYZ coordinates. The point cloud is a powerful piece of documentation that has much greater...
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For officer-involved shooting scenes, an important benefit of using laser scanning is the ability to map bullet trajectories because they can indicate from where a gun was fired. They can show possible locations of the shooter and victim, or potentially how tall or short the shooter was.

Eliminates Guesswork on Evidence Gathering

Before scanning became available, a crime scene technician or investigator usually decided what evidence was important enough to be documented and had no feasible way to capture all the scene’s evidence. “If we came to, say, an officer-involved shooting scene and we looked around and decided just a few specific pieces of evidence were important, we would map these and only this evidence would be on a diagram,” said Bryon O’Neil, a criminalist and forensic reconstructionist with the Clackamas County (Oregon) Sheriff’s Office. “But there might be evidence in these scenes that you didn’t know was important at the time, which was not captured.”

This becomes a troubling issue because an officer who was part of a shooting incident is barred from talking to anyone about the incident for at least 24 hours. “It could be a day later that we learn from the officer or a witness that a particular piece of evidence is what sparked the whole incident,” O’Neil continued. “If we didn’t capture this evidence, it may be gone 24 or 48 hours later.” A laser scanner would have documented all evidence in the entire scene, which is why O’Neil uses a laser scanner due to its speed, high accuracy, and ability to scan and capture a scene in a large radius. O’Neil uses a FARO 3D X 330 Laser Scanner, and FARO CrashZone to create 3D diagrams and animations.

The Importance of Video, “Stacking” Evidence

A big development associated with shooting scenes is that, unlike 30 years ago, incidents today are being caught on camera, including video cameras, security cameras, people’s cellphones, body-worn cameras, or in-car cameras. Capturing incidents on video is helpful because the footage becomes precious scene evidence that could be instrumental in decisions to be made about the officer’s use of force and the circumstances of the incident.

Video is critical to have for another key reason: it can be incorporated with the laser scan data of an officer-involved shooting to create an accurate reconstruction of where people were positioned at the time of the shooting. Not only can the positions of the shooter and victim be shown, but distances and bullet trajectories can be accurately measured and displayed, too.

While O’Neil is a proponent of using any video footage available with laser scanning, he argues that scanning should also include any other elements that contribute to building a solid scene representation. “It’s about stacking your evidence,” O’Neil said. “You’ve got the scan of a scene, photos, witness testimony, and video. The more you can stack on to show that what you say is what happened, the better off you are. If we lose one of these items, we can rely on the others. It’s redundancy.”

Bullet Trajectories Reveal Key Details

For officer-involved shooting scenes, an important benefit of using laser scanning is the ability to map bullet trajectories because they can indicate from where a gun was fired. They can show possible locations of the shooter and victim, or potentially how tall or short the shooter was. “We want to find out where a bullet went,” explained Sgt. Brian Wangler, criminalist with the Larimer County (Colorado) Sheriff’s Office, who has been involved in mapping several officer-involved shooting scenes since his agency began using laser scanning in 2013. “If I have two known points indicating where the bullet traveled, I can draw a digital line within the point cloud showing the path of the bullet. As long as I have scan data, I can keep extending that line back, and this might give us an idea of where to look for the bullet.”

For one incident, Wangler used a FARO Focus S 120 Laser Scanner to scan a suicide scene that involved a shooting. Similar to other scanners, the FARO Focus S 120 Laser Scanner documents a scene’s total environment and complex geometry, and creates a three-dimensional digital model of the surrounding space and objects. For the scene that Wangler scanned, he was able to trace the trajectory path of a bullet through a double-pane glass window. Investigators had obtained
The above two images show two bullet trajectories from a drive-by shooting scene, recreated using 3D scan data. Images courtesy Larimer County Sheriff’s Office.
Wangler's investigation did not stop with this progress. From the autopsy, he had photos with measurements showing the entry and exit of the bullet as it traveled through the victim's head. A Styrofoam head was used to represent the victim’s head with injuries. Next, a trajectory rod was placed through the head that identified the path of the bullet. Finally, Wangler scanned the head with trajectory rods using a handheld laser scanner. Armed with this scan, he imported the data into the original point cloud that was captured at the shooting scene, and he lined up the two trajectory lines to estimate the victim’s location.

**Older Trajectory Methods Less Reliable**

In cases where the bullet trajectory may be relatively simple, the traditional stringing or photographic methods can be tedious, but can yield accurate results. However, when the bullet impacts occur on the interior of a car, restrictive areas, or in shooting scenes ranging over long distances, stringing or other manual methods may not be practical.

With laser scanning, showing a trajectory within the point cloud is easy, immediate, and accurate—plus, the investigator can easily obtain critical measurements from the data in the context of the crime scene. "The scanning data allows us to show a wealth of evidence," Wangler said. "Being able to place trajectories into the scanned scene and visualize them in 3D is priceless compared to just taking photos and performing aerial photography.”

**Positions of People, Evidence in Shooting Scene Critical**

The environment for any shooting incident is always unique. The elements, such as buildings, cars, cartridge casings, blood, rooms, objects in rooms, even tread marks on a road where a suspect might have fled the scene in a car, are all important and need to be documented. A key objective with any shooting reconstruction is to put people involved in the incident back in place within the scene. It’s critical to determine where the shooter and the victim were positioned and how they were oriented for each fired shot. This information is especially useful when considering eye witness accounts and the sequence of events.

The point cloud produced by a scanner can be used to corroborate or dispute eye witness testimony through perspective, distance, and making it digitally possible to verify what may or may not have been visible. In many cases, a reconstruction using laser scan data can reveal details that were not completely obvious to the investigator at first glance.

**Large Shooting Scenes Well-Suited for Scanning**

How valuable laser scanning is for shooting incidents became clear to the Portland (Oregon) Police Bureau, in December 2012 when an active shooter opened fire inside the food court of the Clackamas Town Center shopping mall, killing two people and seriously injuring a third person. The gunman fired 17 shots, including a self-inflicted bullet wound to his head. Using a Leica ScanStation C-10 laser scanner, criminalists spent more than nine hours taking 13 scans inside the mall after the shooting. The images helped investigators determine
the gunman’s path and the trajectory of bullets as they studied ejected bullet casings and objects struck. The criminalist team placed a trajectory rod into a bullet hole in a food court advertisement and then scanned the scene. Using Leica’s Cyclone software, they could model the rod in 3D and extrapolate a line at the angle of the bullet’s trajectory. This showed where the gunman was standing when he fired that bullet. According to a news story posted on OregonLive.com, the shooter was randomly firing a stolen AR-15 rifle when he first struck and killed one of the victims 110 feet across the mall’s corridor. In the OregonLive.com report, Portland Police Bureau Criminalist Ken Jones said about what the scanned data revealed: “It does answer questions as to how the event unfolded.”

**Creating Different Perspectives a Key Advantage with Scanning**

Providing various hypothetical but plausible scanned scene representations of a shooting scene is another huge benefit that laser scanning provides. The case of David Camm, an Indiana state trooper who was tried three times for the murder of his wife and two children, and acquitted after the third trial, is excellent for showing how multiple scanned scenarios were helpful for explaining the crime’s events.

On the day of the homicide, which occurred in 2000, Camm returned to his house after playing basketball and found his wife and two children murdered inside the family’s Bronco in the garage. His wife was shot as she was standing by the passenger door of the car, and the two children, sitting in the rear passenger and driver seats, were also shot.

The most important point in the trial was bloodstains found on the shirt that Camm was wearing. Forensic analysis showed the blood belonged to Camm’s daughter; the prosecution claimed the presence of the blood proved he fired the gun. Although there was a huge amount of blood spatter in the Bronco, Camm’s shirt only had a small amount of blood: eight droplets in the lower left area of his shirt. It was determined to be very unlikely that David Camm could have fired the gun inside the vehicle and from the outer passenger door since the side most exposed to blood droplets would have been on his right side.

This scenario was reconstructed by scanning the family’s Bronco with the trajectory rods to show the bullet trajectories. Three-dimensional character models were placed into the reconstruction to show different positions for the shooter and victims. It was helpful to the jury to see these scans and reconstructed scenarios in 3D because it was difficult to visualize the different scenarios proposed by experts considering the tight and complex positioning of trajectories and bodies inside and outside of the vehicle.
Evidence Technology Magazine • Summer 2017
www.EvidenceMagazine.com

3D LASER SCANNING

Vehicle. Ten years after the incident occurred, it was possible to document the bullet impact points on the windshield, through the back seat, and into the trunk liner. There were still some blood stains from the children’s injuries. All of this could be documented later and reconstructed to show where the bullet trajectories came from.

The laser scans showed that Camm was not in a position to fire the shots as was suggested at trial. The jury most likely gained a much better understanding of what happened, or may not have happened, by viewing the reconstruction based on the laser scan data.

Solid Forensic Science Still At Core of Crime Investigations

The Camm case illustrates the validity of laser scanning as a helpful forensic investigative technology tool. But scanning should not be viewed a “wonder tool,” according to Haag, the New Mexico forensic expert. Scanned evidence is “not irrefutable,” Haag said. “From the defense side, when scan data is presented, the defense is becoming more educated with regards to how to challenge it. So, it becomes more incumbent on us, as forensic scientists, to be able to properly and scientifically defend it.”

Laser scanning is still very new to many law enforcement agencies, and many have not yet adopted it. However, scanning’s advantages are clear, and compelling: fast scene documentation, higher accuracy, ability to compare witness testimony to scene scans, showing bullet trajectories/placement of people and evidence, 3D models that can be animated for fly-through presentations, and widespread acceptance of scan data in courtrooms. Because scanners capture a shooting scene so completely just as it occurred at the time of the scan, the data is invaluable if a case reopens and the scene’s evidence must be re-examined. Also, since scan data can be shown to attorneys, jurors, and judges, it can change the outcome of a case.

For all of scanning’s many advantages, and its effectiveness as a crime investigation tool, it should not be viewed exclusively as the cure-all for presenting the evidence in any case. Although Haag readily affirms that scanning is the next level of any kind of crime scene investigation, he reminds us that good investigations rely on much more. “It comes down to proper training and having a good investigator who knows how to manipulate and use that scanner tool to its utmost potential.” Haag said.

About the Author

Eugene Liscio is a registered Professional Engineer in the Province of Ontario, Canada and is the owner of AI2-3D, a consulting company that specializes in 3D forensic documentation, analysis and visualizations. Liscio has testified in court in both the United States and Canada utilizing 3D technologies such as photogrammetry and laser scanning and has also provided interactive 3D crime scene reconstructions to aid the jury. Liscio has been called to aid police agencies in Canada and the U.S. and was retained to assist the Ontario Provincial Police in the shooting at the Canadian House of Commons. He is past President of the International Association of Forensic and Security Metrology (IAFSM) and is an Adjunct Professor at the University of Toronto, where he teaches a 3D forensic reconstruction and mapping course as part of the Forensic Sciences Program. Eugene is actively engaged in research and mentoring students focusing on 3D documentation and analysis techniques.
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