SHOTS FIRED!: THE FORENSIC RECONSTRUCTION OF POLICE-INVOLVED SHOOTING INCIDENTS

Michael A. Knox
Knox & Associates, LLC
P.O. Box 8081
Jacksonville, FL 32239
(904) 619-3063
www.knoxforensics.com

ABSTRACT

Forensic reconstruction of shootings by police is an important tool in litigating claims arising from police use of deadly force and alleged violations of civil rights. This paper will provide an overview of the value of a competent forensic reconstruction, including an explanation of what can and cannot be discerned from such analysis. This paper will address a number of issues, including: (1) whether or not video of a shooting incident provides a complete and accurate portrait of what took place during a shooting incident; (2) how audio recordings can be incorporated into a shooting reconstruction to help establish the sequence of events and event timing; (3) how the fact that a person was shot in the back does not mean that he was not posing a threat to officers; (4) how to deal with statements by officers that do not comport with the physical evidence or that conflict with statements made by witnesses or other officers; and (5) how technology provides tools for the forensic reconstruction of shooting incidents that make it possible to effectively and efficiently present an analysis to a jury.

INTRODUCTION

The use of deadly force by law enforcement officers exposes officers, police agencies, and municipalities to substantial litigation, much of which owes to the unique nature in which the legal system treats alleged civil rights violations by persons in authority. Deaths and injuries by gunfire in most contexts are litigated in state courts as negligence claims; however, most lawsuits arising out of police-involved shooting incidents are litigated in Federal court where the rules of civil procedure are stringent and no financial caps are placed on claims.

While legal issues are often key to litigating civil rights violation claims, factual issues are typically the basis of such claims. Unfortunately, public perception and understanding of the myriad complex issues surrounding police use of deadly force are typically lacking both in terms of depth and breadth. In many cases, even the attorneys charged with defending the officers and agencies have a limited understanding of these issues.

In order to develop a clear picture of the factual issues surrounding a police-involved shooting, a competent, complete forensic reconstruction is needed. The role of the crime scene[1] reconstructionist is to evaluate the physical, documentary, and testimonial evidence in context and develop a comprehensive outline of the likely sequence of events, including determining the locations from which shots were fired, determining the path the bullets took, and evaluating the result of each shot and its impact on the overall event sequence.

A competently-performed shooting incident reconstruction requires a strong mechanical background, including knowledge of the dynamics and biomechanics involved in the shooting process; an expertise in firearms; ability to compute the mathematical equations of exterior, interior, and terminal ballistics; knowledge of gunshot wounds, range of fire, and the deposition of gunshot residues on clothing and human tissue; an understanding of the relevant human factors issues including visibility, lighting, and perception-reaction time; and, most importantly, the ability to convey the sum total of the reconstruction to a lay jury verbally and through demonstrative visual aids.

In any shooting event, the shooter should only be judged on what he or she reasonably perceived in the moments leading up to the shooting; facts learned afterward are of no practical consequence because the shooter's decision to fire has already been made and cannot be undone.

VIDEO & AUDIO RECORDINGS

There is a common misconception that video and, to a lesser extent, audio recordings of a shooting incident accurately tell the story of what happened. While recordings do tell *some* of the story, neither can tell *all* of the story. With very few exceptions, the types of video recordings that one will encounter in the context of reconstructing a shooting incident will be two-dimensional representations of a three-dimensional world; perception of depth and distance will not be the same as they would be for a person viewing the events live as they folded. Also, both video and still photographs provide only the camera's perspective, which is not likely to be the same as that of the shooter. Even portable video cameras being worn by officers in some jurisdictions show only the camera's perspective, which, albeit in close proximity to the officer's head, does not reflect the subtleties of perception that result from eye movement, focus, attention, and cognitive processing.

[1] The terms "crime scene" and "crime scene reconstruction" as used in this paper do not imply that the shooting is criminal in nature, only that it is reconstructed as though it may be criminal in nature. In either event, the reconstruction process is the same. The terms are used generically for any shooting incident, including those done justifiably by police.

 © Copyright 2012 by Knox & Associates, LLC

One prime example of a shooting in which video evidence not only failed to tell the whole story but also provided a misleading account of the events is the 2003 fatal shooting of Marquise Hudspeth by Shreveport, Louisiana police. Hudspeth was shot in the back by police in a convenience store parking lot after the termination of a vehicle pursuit. Several camera-equipped police cars captured video of the shooting. In one video, officers are seen shooting Hudspeth as he walks away in what appears to be an execution; however, video from a second police car clearly shows Hudspeth using both hands to point something at officers in what is clearly intended to be a threatening shooting stance. The object, it was later discovered, was a cell phone, but what the video, when analyzed frame by frame, tells is a story in which the officers clearly perceived a threat.



In the upper frame from police video, Marquise Hudspeth, while walking away from officers, turns suddenly and points a cell phone at an officer; in the lower frame, the officer reacts to the perceived threat by ducking.

To be sure, video evidence is valuable to the reconstruction of shooting incident. What has been recorded can provide valuable insight to the sequence and timing of events. However, video evidence must not be given more weight than it deserves. Video evidence is merely another piece of the puzzle, and it must be evaluated in context with all other evidence with strong consideration given to its limitations and constraints.

While video evidence may provide valuable visual cues for a shooting reconstruction, audio recordings may be equally valuable, particularly with respect to timing and sequence of events. Audio recordings may also shed light on verbal commands given by officers and threats made by individuals who were ultimately shot by police. Audio recordings are likely to recovered piecemeal because various sources may exist: 911 calls, police radio transmissions, recorders carried by officers, audio tracks of video recordings, and so forth. To properly use such evidence in a shooting reconstruction, one must devise a way to compile all such recordings into one continuous timeline so that any one recording can by fit in sequence with all of the other recordings. Computer software can be used to stitch together the various recordings, which can then be transcribed. The final recording provides a timeline of the events, and if the transcript is put to video, a powerful demonstrative aid can be presented to the jury.

Both video and audio evidence may require enhancement to be useful to a shooting reconstruction. The types of recording devices encountered at shooting scenes are generally not of professional broadcast quality, so the clarity of the recordings may leave much to be desired. Computer tools for the enhancement of video and audio have become commonplace, and often these tools are relatively low cost.

SHOT IN THE BACK

One the most common allegations in police shooting litigation is that, if the decedent was shot in the back, it was not possible that he or she was posing a legitimate threat to the officer. Many laypeople take a simplistic, black-and-white position on this issue: if the person was shot in the front, the shooting was justified; if the person was shot in the back, the shooting was not justified. However, shooting incidents are much more complex than this viewpoint.

In a shooting reconstruction, timing and sequence are key issues. It is not enough to simply determine what happened; one must understand the timeline of the events and consider the relationship between event timing and the associated perception-reaction issues that affect one's ability to deliver deadly force. The shooting process is not instantaneous; there is a chain of events that must take place before a shot is fired.

First, the shooter must perceive some threat and formulate a response decision. Perception requires the shooter to form some visual image based on data that are being transmitted. During a real-world shooting scenario, the shooter is receiving a tremendous amount of data, some of which is useful signal, but much of which is simply noise that provides no meaningful information but may slow one's ability to process all of the data being received. The more noise that is present, the slower the processing and the more likely that the officer will be mistaken in his or her perception of what is happening, e.g., mistaking a cell phone or a wallet for a gun. It is important, therefore, to assess all of the data the officer was receiving and not just focus on key pieces of signal that are at issue.

To perceive a threat, an officer must first form a visual signal on the retina that gets transmitted to the brain. Albeit very short, there is a time latency for that signal to be formed and transmitted. The brain must then process the signal, perceive the threat, and formulate a response. Typical real-world scenarios encountered by police involve either recognition responses (shoot-don't shoot) or choice responses (shoot, use a taser, use other force, etc.). Research has shown

 © Copyright 2012 by Knox & Associates, LLC

that typical perception-response times by officers to simple decision signals (e.g., when the light comes on, fire at the target) are on the order of one-half to two seconds, depending on whether the officer has pistol in hand or must draw from a holster. Research has also shown that a typical subject can turn 180 degrees in about one-half second. What this research means is that, even when an officer has pistol drawn and ready to fire, the subject can turn completely around as or more quickly than the officer can react and fire.

The officer's perception-reaction time aside, a person does not have to be facing an officer to pose a deadly threat. Handguns can easily be fired over one's shoulder or around one's torso. In such a scenario, the decedent is likely to suffer gunshot wounds to his or her flank. Wound path angles often indicate whether a subject was stationary or turning while shots were fired, and this evidence can be critical in establishing the actions of the subject. While the direction of turning may not be evident on the basis of a medicolegal autopsy alone, when put in context with other evidence, the direction of turning may become clear.

One point is worth mentioning: this type of analysis must be done by someone who is competent and qualified as a crime scene reconstructionist; experts such as forensic pathologists and laboratory firearms examiners are not automatically competent or qualified to perform crime scene reconstruction because they may lack the practical crime scene experience or the overall general forensic science background to comprehensively piece together the evidence in context. The author has experienced on a number of occasions faulty crime scene reconstruction analysis put forth by opposing experts who, though very qualified in their respective disciplines, had neither the qualifications nor the competence to properly reconstruct a shooting incident. In one police shooting case with which the author was involved, a faulty crime scene reconstruction put forth by a former chief medical examiner in a Southern state working on behalf of the plaintiff was excluded by the trial court after the author proved a number of deficiencies in the doctor's analysis.

CONTRADICTORY STATEMENTS BY OFFICERS

In police-involved shooting litigation, it is far from uncommon to have an officer make statements about the shooting that do not comport with the physical evidence or to have officers involved in the shooting give conflicting testimony about what took place. While plaintiff's counsel may wish to capitalize on such inconsistencies, the truth may be innocuous. Shootings are fast-paced events; those involved, including eyewitnesses, must process a large amount of data in a short period of time. Data processing is a function of many factors, not the least of which is the person's perspective within the scene. What one individual processes as signal versus noise may not be the same as what another person processes. First, each person must actually see the same things, which may not occur. Second, each must process what was seen with the same significance, which is even less likely to happen. An individual's processing of signal is influenced by his or her experiences, biases, training, education, motivations, and awareness; the combination of these factors is unique to the individual.

Officers often provide information about what they recall that directly conflicts with the physical evidence; while there are certainly cases in which the officer is being purposely untruthful, most often it is because he or she simply has a faulty recollection of the events. Likewise, an officer who is unable to recall key details is not necessarily being untruthful but may simply not recall those details. As with most people, officers wishing to thwart an investigation are more likely to concoct details about a shooting than they are to simply leave blank what will certainly be perceived as significant lapses in memory; a skilled interviewer with experience in police-involved shootings or internal affairs cases may be able to get the officer to admit the truth.

In one case the author reconstructed, two officers were present when one of them accidentally shot a man who was attempting to flee and collided with the officer during a burglary investigation. The officers gave markedly conflicting testimony about what took; the witness officer's account was consistent with the physical evidence, but the shooting officer testified at deposition in the ensuing civil rights litigation what he was never in the room where the shooting took place and instead testified that the shooting happened at the other end o the abandoned house. In that case, enhancement and analysis of an audio recording made by the witness officer allowed the timing of the events to be clearly established; the timeframe from when the shot was fired to when the witness officer ran outside in pursuit of the subject established that the two had traveled from the far end of the house, consistent with the witness officer's statement and the location of the ejected cartridge case. Furthermore, in the immediate aftermath of the shooting, the witness officer twice told other first responders that the shooting occurred accidentally when the subject collided with the other officer. In the end, the case settled quite favorably to the police department and the officer that fired the shot.

When evaluating statements made by officers and witnesses, it is important to use a proper crime scene reconstruction to evaluate key statements. In particular, one must recognize statements regarding facts that the officer or witness could not have known at the time. In one case the author reconstructed, an officer gave a videotaped walk-through interview at the location of the shooting and described the position the subject was in as he turned toward the officer just as the officer fired his first shot. A stand-in model was used to play the role of the subject, and the officer, standing in the position from which he recalled firing, directed the model to pose in the position and location the officer recalled the subject being in when the first shot was fired. The position and location of the model subject was almost identical to what the author had determined as the most likely position and location for the subject prior to having knowledge of the officer's walk-through interview. In this case, the officer could not have known at the time of the interview that the position and location he described for the subject and the location from which he recalled firing was entirely consistent with the physical evidence. In contrast, conflicting statements by multiple eyewitnesses all had significant details that did not comport with the physical evidence.

TECHNOLOGY FOR RECONSTRUCTION

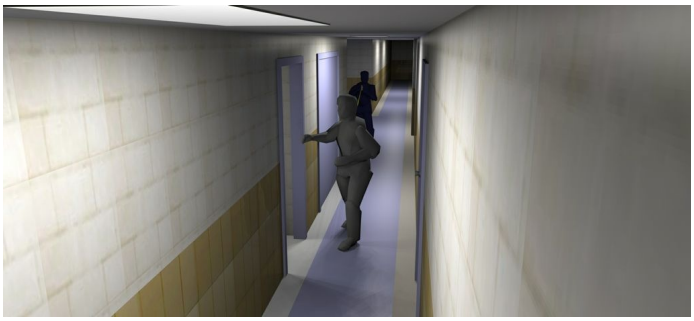
We live in the 21st century, the most technological age in history thus far. Technology has grown by leaps and bounds in recent years, and there is no reason why the technology used in the reconstruction of shooting incidents should do any less. Tape measures have given way to laser mapping systems and

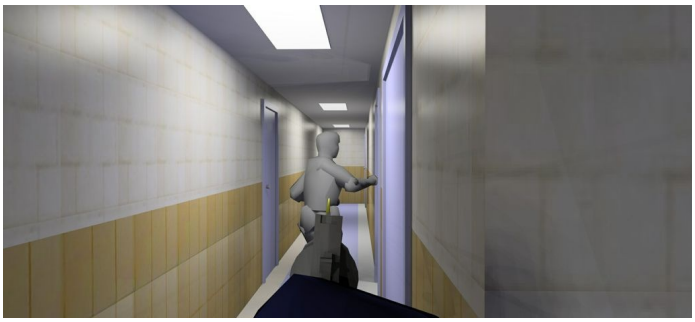
 © Copyright 2012 by Knox & Associates, LLC

point-cloud scanners that provide amazingly accurate and complete detail of a shooting scene; hand-drawn diagrams have given way to life-like three-dimensional computer renderings of the scene; poor quality video, audio, and photographic recordings of the events can be substantially enhanced by sophisticated computer algorithms; and, computer simulation of the events can provide substantial insight that would otherwise never be known.

Three-dimensional computer modeling offers the analyst an environment in which various scenarios can be tested. Two-dimensional diagrams, while useful in many respects, do not account for changes in elevation, a significant factor in determining the location of a shooter. Computer models also provide the litigator with compelling demonstrative exhibits that show a jury the results of a comprehensive shooting reconstruction. Photorealistic rendering packages produce photograph-like representations of the model that include accurate lighting, reflections, and glare.

Three-dimensional computer models are the basis of computer animation, which can be used to illustrate events in motion. To be sure, sophisticated computer animations take tremendous amounts of time to build and render, and, hence, are quite costly; however, when put into context against the exposure to liability, the investment may be quite cost effective. Computer animation of shooting incidents can, however, be more difficult to get admitted at trial; moving animations contain more detail of an event, which provides more for adverse counsel to challenge. Photorealistic renderings of computer models can also provide an accurate portrayal of the perspective of an officer or witness.

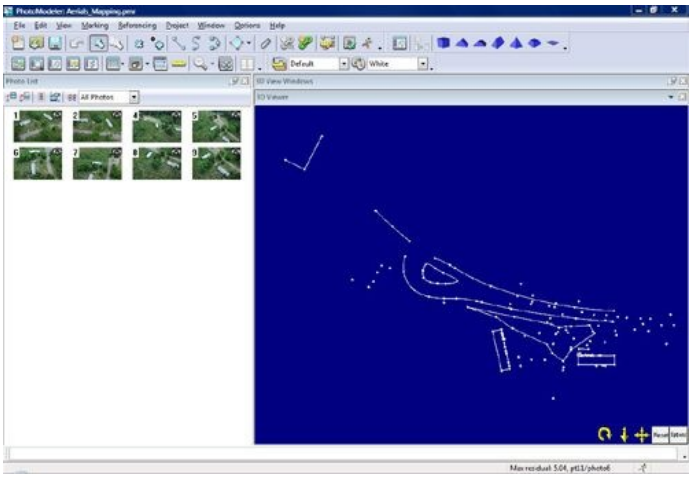




These photorealistic computer model renderings of a shooting scene accurately portray lighting and perspective, two key issues in a police-involved shooting.

Another three-dimensional mapping and measuring tool is photogrammetry, the science of obtaining measurements from photographs. Photogrammetry has a number of applications in the reconstruction of shooting incidents including mapping and modeling; obtaining measurements of inaccessible locations; and, obtaining measurements of evidence of scene features from photographs of the crime scene even when those measurements were not obtained by investigators at the scene. The author has used photogrammetry to obtain accurate three-dimensional measurements of a scene on a plaintiff's property by helicopter. Photogrammetry can also be used to obtain measurements of a person from surveillance video.





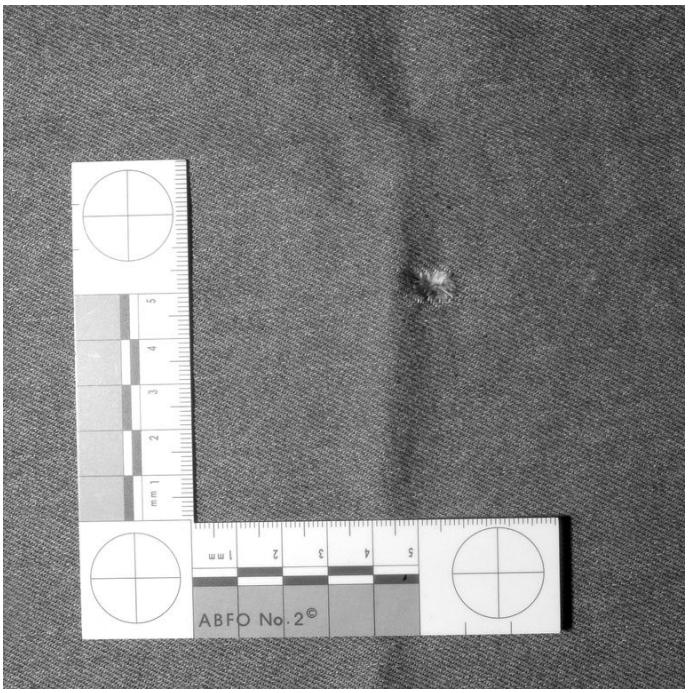


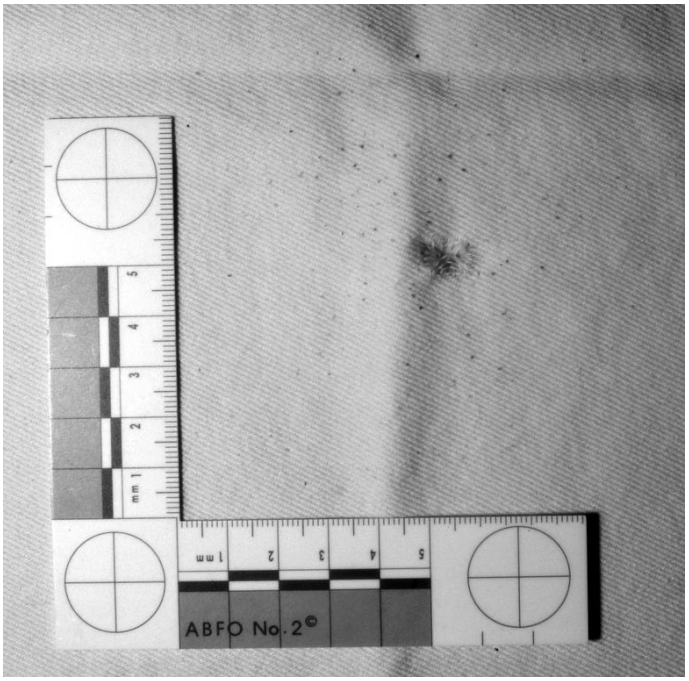
These images show how photogrammetry can be used to obtain scene measurements from aerial photographs and to obtain the height of a person from a convenience store surveillance video.

Another tool that is quite useful in shooting reconstruction cases is digital infrared photography. Most digital camera sensors are sensitive to infrared radiation; however, visible pass

 © Copyright 2012 by Knox & Associates, LLC

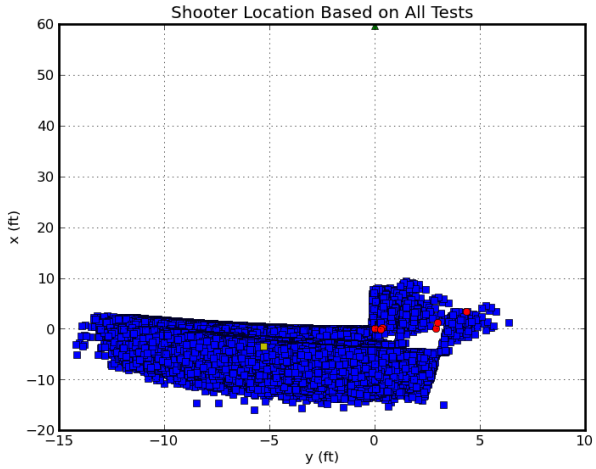
filters are installed to prevent infrared radiation from affecting photographs. Fuji offers a forensic digital camera model that is sensitive to both infrared and some ultraviolet radiation. There are also companies that will remove the visible pass filters from many popular digital camera models. In the context of shooting incident reconstruction, infrared photography is most useful in developing images of gunshot residue, particularly on dark-colored clothing where the lack of contrast makes visualization of gunshot residue patterns difficult. Infrared photography has even been successfully used to record gunshot residue patterns on clothing saturated with blood. While this technology is in many respects vastly superior to other methods of visualizing gunshot residue patterns, its use in forensic laboratories and by crime scene investigators is not commonplace, so litigators handling police-involved shooting cases may wish to seek it out when gunshot residue deposition and range of fire are at issue.





The photographs shown to the left are visualizations of gunshot residue patterns on blue denim material with the top photograph showing visible light only and the bottom photograph showing infrared radiation only. In the bottom photograph, the denim material reflects a large quantity of infrared radiation, which causes it to turn white providing greater contrast against the dark-colored gunshot residue particles.

Other new technologies used in shooting incident reconstruction include computer simulations to develop probability models for determining a likely area for a shooter based on the locations of ejected cartridge cases. Employing Monte Carlo simulation methods like those used in a number of scientific applications, data from a small sample of rounds fired in controlled testing can be used to predict very large samples that can be correlated to ejected cartridge cases at the scene. Using these models, areas representing various confidence intervals can be used to determine the probability that a shooter was within the specified area, as well as to eliminate other areas based on low probability that the shooter fired from those areas.



This plot shows the probable location of a shooter based on a Monte Carlo simulation developed from data obtained from test firing the involved pistol in a controlled experiment. The red points represent the cartridge cases found at the scene, and the blue points represent possible locations of the shooter based on the pattern of six ejected cartridge cases.

CONCLUSION

Forensic reconstruction of police-involved shooting incidents is a valuable tool for the litigator handling claims arising from police use of deadly force. Forensic reconstruction of the shooting helps the litigator understand the facts of the case and puts into context the myriad complex issues surrounding the shooting event. The application of new technologies to the reconstruction provides a depth and breadth that otherwise is likely to be missing from litigation.

ABOUT THE AUTHOR

Michael Knox is a board certified crime scene reconstructionist with over 15 years of law enforcement experience who provides forensic consulting services through his company, Knox & Associates, LLC. Mr. Knox has a B.S. in mechanical engineering from the University of North Florida and an M.S. in forensic science from the University of Florida. He has testified as an expert in state and federal courts in Florida, Alabama, Texas, and Illinois and has provided training to law enforcement in Peru, the United Arab Emirates, the Republic of Georgia, and throughout the United States.

 © Copyright 2012 by Knox & Associates, LLC