DIGITAL MEDIA FORENSICS & OFFICER-INVOLVED SHOOTINGS

Scientifically Accurate Scene Reconstruction & Analysis

KNOTT LABORATORY, LLC

Digital Media Forensics

Law enforcement agencies and investigators face increasing challenges, not least of which, the overwhelming volume of digital evidence associated with cases.

When a critical incident occurs, most law enforcement agencies do not have the resources, staff, and training to perform in-depth analysis on the digital evidence associated with each case. And yet, these pieces of digital evidence can end up in the media to be tried by the court of public opinion.

This is why Knott Laboratory created Digital Media Forensics; a new division to assist law enforcement and attorneys with the analysis of digital evidence.

Digital Media Forensics takes the existing digital evidence obtained through regular detective work to recreate scientifically accurate crime scenes in 3D. From these scene reenactments, we can apply forensic engineering methods to discover facts in the case that were previously unobtainable. The digital evidence is then meshed in a variety of formats to clearly present the case, whether to a jury, investigation teams, or the public.

For example, Digital Media Forensics can use video, audio, and GPS evidence from:

- Body worn cameras
- Surveillance cameras
- Patrol dashboard cameras
- Cell phones
- Video doorbells
- Traffic cameras
- Photographs from the scene
- Drone footage
- Event Data Recorders (vehicle black box)

And merge this evidence with a Point Cloud, such as from a FARO scanner, to find these key factors:

- Positions of people, vehicles, and objects
- Second-by-second timeline of events
- Alternate perspectives (i.e., from each officer's vantage point)
- Speed, pitch, yaw, roll, and angles of objects
- Locations of evidence
- Points of rest

Video footage and photographs are important pieces of evidence, but they do not tell the whole story of an incident. Key factors are not accurately represented, such as distance, positions of people and objects, or timing of events.

Digital Media Forensics experts can analyze the digital evidence, correct for distortion and timing issues, and accurately place that evidence in the scene.

This powerful resource provides:

- A better understanding of events for investigators.
- Support to the integrity of the investigation.
- The removal of bias and assumptions.
- Tools to convey the facts of the event to a jury or the community.
- Transparency with the community using objective, scientific analysis.

Let's walk through how the Digital Media Forensics process works using an actual officer-involved shooting analyzed and reconstructed by Knott Laboratory.

Please note, the images below are pulled from the final video used in court proceedings. The full Digital Media Forensics video of this case can be viewed at https://knottlab.com/services/digital-media-forensics/.

INCIDENT SUMMARY

Three officers responded to an apartment complex where a domestic violence incident had been reported. The reporting party stated the suspect was inside the residence and armed with knives and a tree saw. Shortly after officers arrived on scene, the suspect exited the apartment with a tree saw in his hand. The officers gave a verbal warning for the suspect to drop his saw, then engaged the suspect with their duty handgun. The suspect sustained life-threatening injuries and died on scene.

THE OBJECTIVE

Knott Laboratory's Digital Media Forensics team was asked to analyze the available information to reconstruct the timing and placement of the shooting, the verbal warnings, and the parties involved to scientifically identify facts in the case.

THE PROCESS

1. Gather Data

All three officers were equipped with body worn cameras at the time, however, only two officers had their cameras recording during the events of the shooting. Two of the responding officers also had their cruiser dash camera footage rolling as they drove into the parking lot. This video footage and a high-definition laser scan of the post-incident scene were provided for analysis.

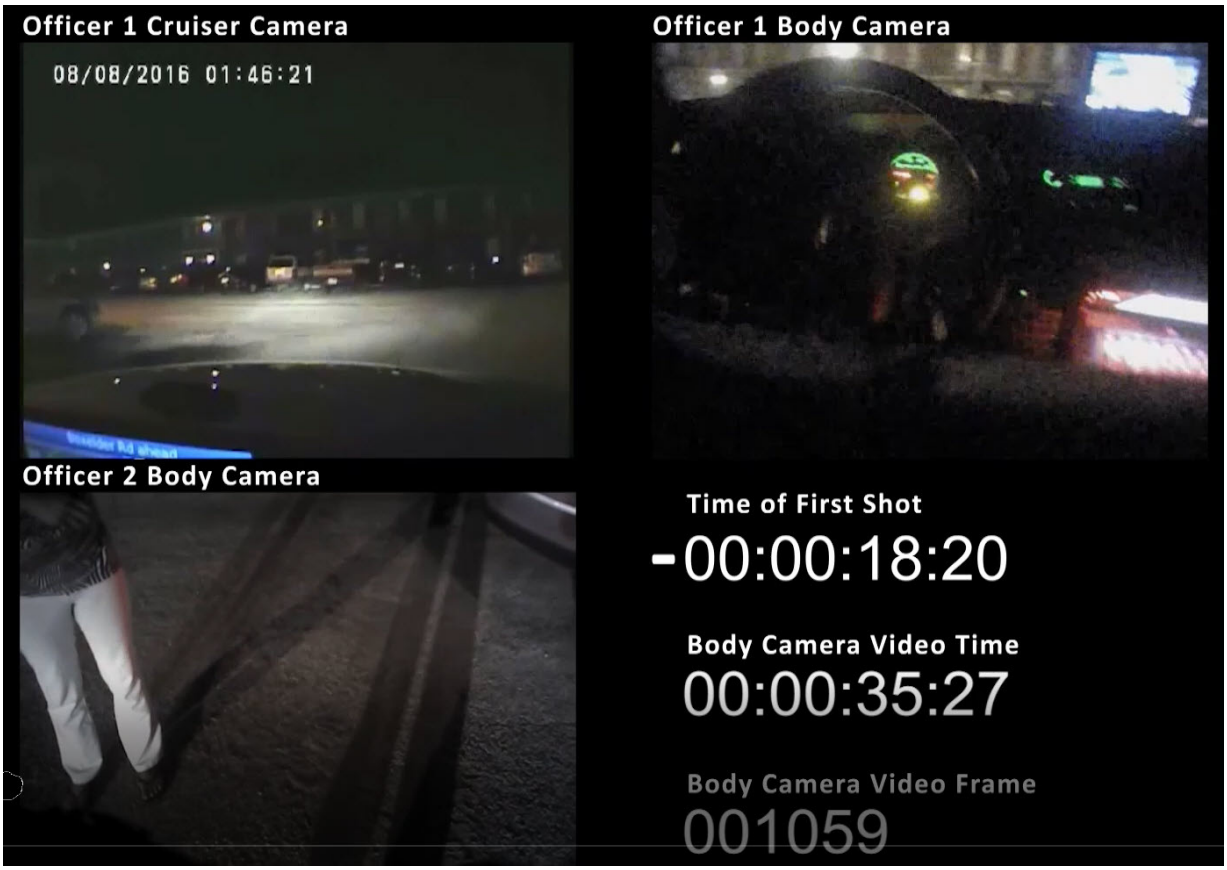

Figure 1: Multi-view of BWC and Vehicle Dash Camera time and audio matched.

THE PROCESS - CONTINUED

2. Aggregate Data

The Digital Media Forensics team started by aligning each of the videos and audio footage correctly in time with each other. We then proceeded to use the process of videogrammetry to calibrate and establish the 3D positions of each body camera and cruiser camera within the laser scan of the site.

In the instance where we did not have BWC footage from one officer, we matched a digital surrogate model based on the other footage to provide his location. We then matched what we could see of the suspect coming through the door to get his position. For moments where his motion was not directly captured in the footage, we used a correctly timed motion capture to estimate the rest of his movements.

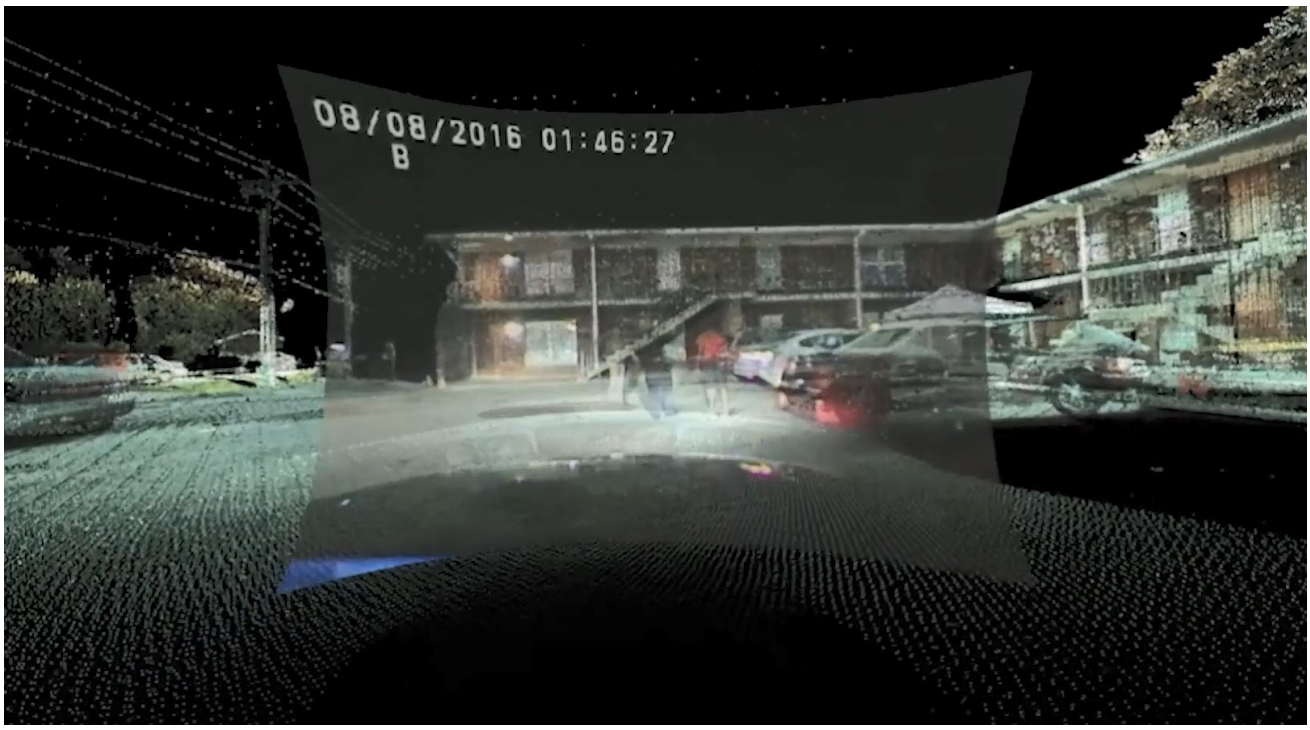

Figure 2: Vehicle Dash Camera footage corrected for distortion and placed accurately in the point cloud. This also allows the expansion beyond the camera's field of view.

Figures 3 & 4: BWC footage corrected for distortion and placed in the point cloud. Again, allowing the viewer to see the officer's actual field of view.

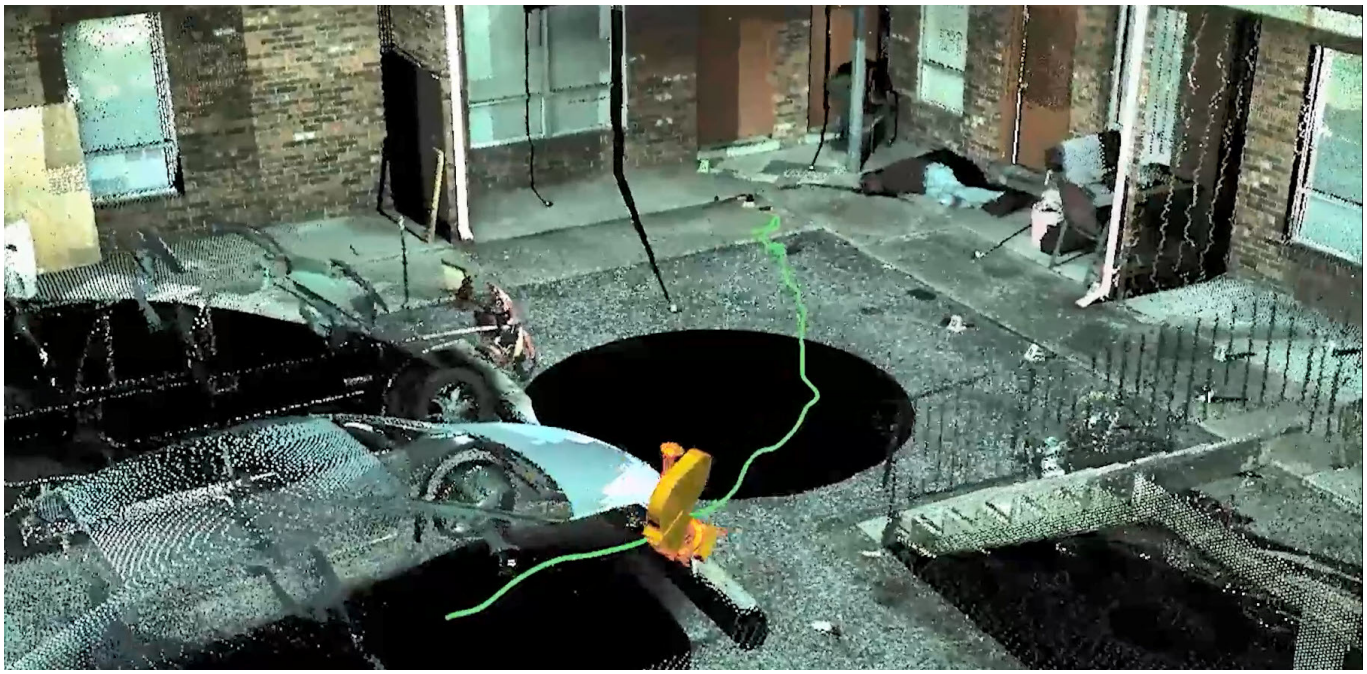

Figure 5: Motion Capture visualization showing the path of the officer during the incident.

THE PROCESS - CONTINUED

3. Analysis

From these camera matches, we can derive everyone's position at every second throughout the event and the timing of verbal commands and actions.

Through the analysis of the data, forensic engineers were able to answer crucial questions in the investigation, such as:

- The exact duration of time between officers giving verbal commands and when shots were fired. In this case, it was two seconds.
- The exact locations, distance, and vantage points of each officer in respect to the suspect. In this case, each officer was no less than 15 feet away from the suspect when the shooting began.
- The suspect's movements and speed throughout the course of the incident. This individual was walking with the pruning saw at his side and well under the average walking speed when officers started to address the suspect.

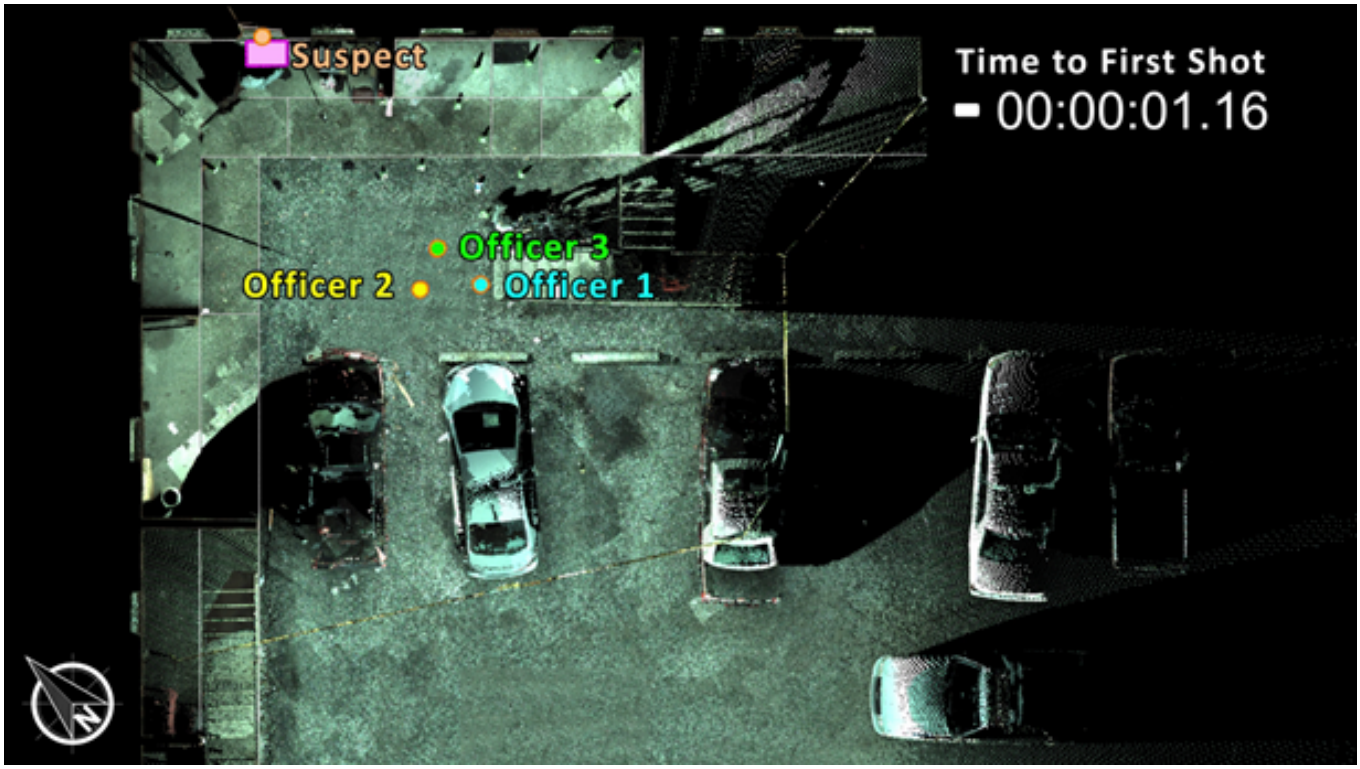

Figure 6: Accurately tracked positions of the officers and suspect throughout the incident.

THE PROCESS - CONTINUED

4. Illustrate & Communicate the Incident

A video presentation was created to show a second-by-second timeline of the incident. Positioning the video evidence inside the laser scan allows the audience to see outside the cruiser or body camera field of view. The video presents multiple vantage points of the incident, along with a running timer, to clearly convey the facts of the case.

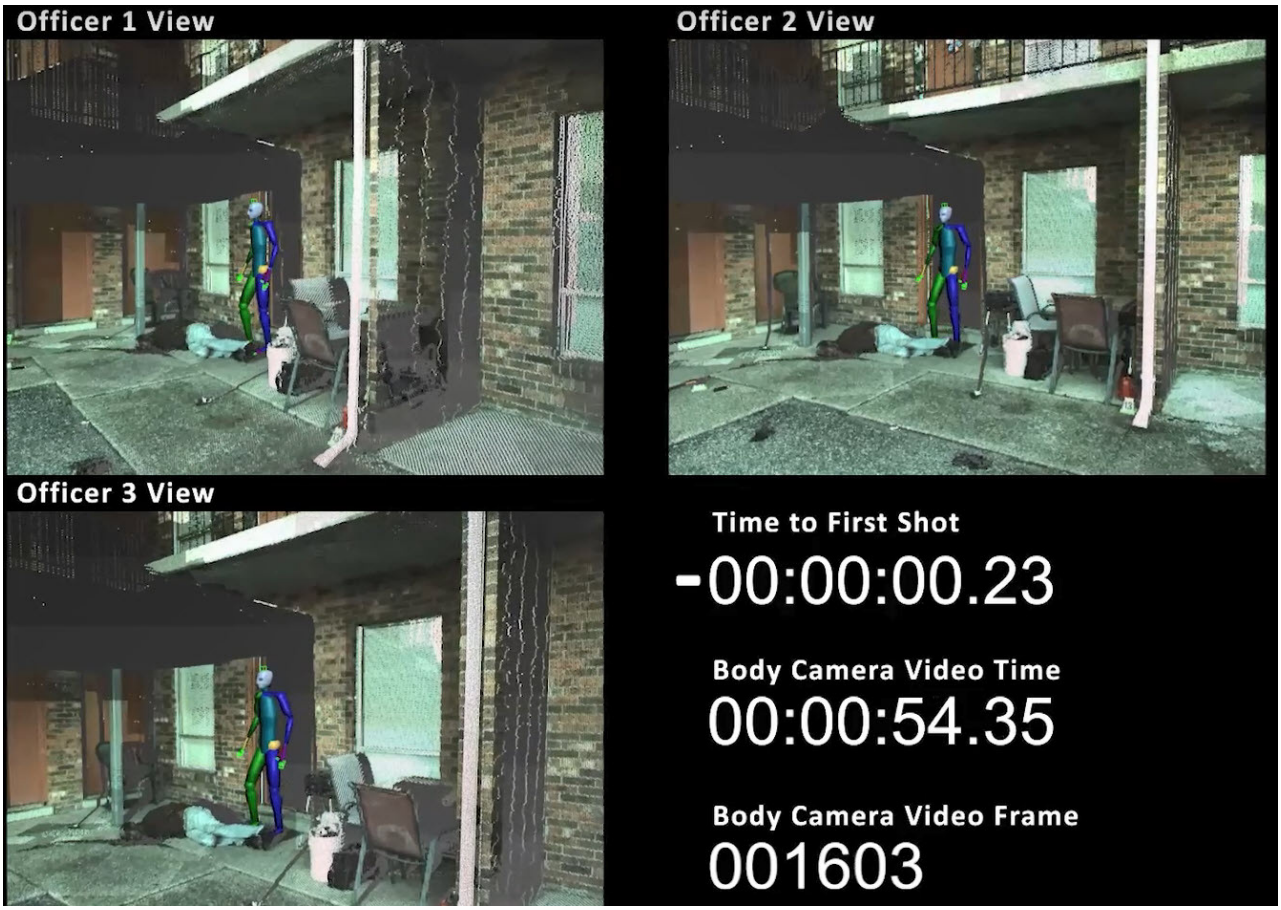

Figure 7: Motion Capture visualization of the suspect's movements along with an incident timer.

CONCLUSION

Law enforcement agencies are constantly asked to provide transparency after a critical incident such as this. The Digital Media Forensics process can provide scientifically accurate information, free from conjecture, to help agencies analyze critical incidents and address all aspects of the case.

ABOUT THE AUTHORS

Jason Evans, B.Sc., M.B.A – Project Engineer

Jason served as a police officer for the Grand Junction Police Department in Colorado for seven years. He spent time as a patrol officer, a school resource officer, and a community resource officer. He was also a firearms instructor for the department. Prior to working as a police officer, he served 10 years in the U.S. Navy as a Submarine Electrician. Jason holds a Nuclear Engineering Degree and a Master of Business Administration with an emphasis in Data Analytics.

Taylor Spiegelberg, B.F.A. – Senior Visualization Expert

Taylor earned his Bachelor of Fine Arts degree in 3D Graphics and Animation from the University of Colorado. As the lead forensic animator, he works with engineers to create visualizations for accident reconstructions and all manner of investigations. Taylor is an FAA certified drone pilot, which allows him to fly commercially to collect evidence from accident and crime scenes. He has knowledge of various 3D software packages to create scientifically accurate visualizations using photogrammetry, matchmoving, photo-modeling, photo and video editing, 3D modeling and animation.

ABOUT KNOTT LABORATORY

Knott Laboratory has been an industry leader in forensic engineering for nearly 40 years. The company is comprised of structural and mechanical engineers, fire and explosion investigators, forensic animators, accident reconstructionists, and digital media forensics experts. This unique combination of expertise allows the company to serve a wide variety of industries, such as, attorneys, insurance companies, construction, community management and law enforcement. Each project is assigned a team suited to the particular needs of the case and client. Knott Laboratory then provides investigation, analysis, animation production, and expert witness testimony.

The company is headquartered in Centennial, CO with locations in Fort Collins, Colorado Springs, Grand Junction, Phoenix, Houston, and San Antonio.

To learn more, visit www.knottlab.com.