Phoenix Police Department
Cooke & Ferragamo 2020-852236

Forensic Video Analysis

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Introduction

On June 9, 2020, my office was contacted by Lt. David Albertson of the Phoenix Police Department in relation to an Officer Involved Shooting Investigation. The shooting occurred on May 22, 2020.

On June 15, 2020, I was officially retained by the Phoenix Police Department in order to conduct an independent analysis of video and audio data relating to the OIS events.

On June 16, 2020, I received a number of exhibits for examination.

In various communications, I have been asked to conduct a thorough analysis of video images and audio data, giving special attention to technical issues in the recordings in order to assist additional investigators in their review of the shooting.

In order to produce an accurate interpretation of technical issues relating to motion blur, speed of movement, contact and positioning of events, I was provided with two Body Worn Camera systems (BWC), their accompanying Evidence.com Audit Reports, and two still photographs of the involved officers.

This report does not comment or opine on Use of Force related issues.

Summary

During this analysis, motion blur examination and interpretation assisted in determining the movements of the officers at specific moments in time.

In addition, it was helpful to consider the visual effects of the fisheye lens used by Axon. The wide-angle effects cause objects to appear misshapen or further from the camera than they were at the time of the events.

Finally, it was also important to consider that timing is more accurately determined from the audio data, rather than from the video data.

Each of these elements are considered in detail.

Motion Blur

The Axon Body 2 camera systems record images for playback at 29.97 frames per second. As a result, each image represents the passage of time of 33.336 milliseconds (ms). The time it takes for the camera to sample light, creating an image (sample period) varies depending on the amount of available light. When the ambient light is low, the camera system takes more time to collect light. When the ambient light is bright, the camera system collects light over a very short period of time.

In the ambient light of the scene in this case, the cameras collected light for a long sample period (possibly as long as 15 to 20 ms) due to the low light levels. As a result, when the camera is in motion, objects within view of the camera appear blurred. When the camera is static but objects within the field of view are moving quickly, the moving objects will be

blurred. When blurring occurs, the direction and length of the blur can be determined, providing additional detail of the activity.

This report carefully examines the motion blur present in both officers' video images in order to provide additional information about the events.

In addition to motion blur, digital video compression has a significant impact on the visual integrity of the images. Axon Body 2 BWC systems incorporate digital video prediction and encode MPEG4 video. The encoding during dark scenes causes the loss of image detail, which is evident throughout these recordings in this case.

Special attention is given in this report to note when compression impacts the reliability of the images.

Fisheye Lens

The Axon Body 2 cameras employ fisheye lenses in order to produce a wider field of view than a non-fisheye lens. The result is that objects closer to the edge of the image will appear distorted. In addition, objects will also appear farther from the camera than they actually are. For example, when Mr. Whitaker exits the apartment door, Officer Cooke appears farther from the door than he actually is. When Officer Ferragamo turns slightly to his left, causing the positioning of Whitaker and Cooke to move into the center of his camera image, their positional relationship is more accurately depicted. Despite their positional relationship being more accurately depicted, they continue to appear farther from Ferragamo than they actually are.

As a result of these issues, and due to the position of the cameras, the video and audio data is not capable of reproducing the visual and audio experience of the officers. Their perspectives and responses to the events are not reproduced by the recordings.

This report will show the following:

- Ferragamo knocked on the door and announced their presence.
- Whitaker opened the door approximately twelve seconds later.
- Whitaker advanced out of the door with a gun in his right hand and finger inside the trigger guard.
- Whitaker moved the gun behind his back briefly, before moving it to his right and forward.
- The gun was briefly visible to Cooke, but when Whitaker moved the gun from his back to the right, the gun and his hand were no longer visible to Cooke or to Farragamo.
- Approximately 2.3 seconds elapsed from the moment Farragamo reacted to seeing the gun, until the first shot was fired by Cooke.
- Cooke fired three shots in approximately ½ a second.
- At the time of the first shot, Whitaker was holding the gun in his right hand.

Qualifications

I am a Certified Forensic Video Analyst with extensive experience in the recovery, scientific examination, and evaluation of recorded video and audio information involving criminal and civil investigations in the United States (US), Canada, the United Kingdom (UK), and elsewhere. I have been continuously active in this science since 1984.

I attained an undergraduate degree in Television Broadcast Communications, with an emphasis on television engineering in 1982.

As a Forensic Video Analyst, I have processed thousands of videotapes and computer discs containing digital multimedia evidence for both criminal and civil cases. I have been providing expert testimony as a Forensic Video Analyst since the early 1990's. In the past ten (10) years I have provided expert testimony in the field of Forensic Video Analysis more than one hundred and fifty (150) times in US and Canadian courts at all levels. I have testified as an expert in Forensic Video Analysis in Washington State, Arizona, California, Colorado, Connecticut, Florida, Idaho, Illinois, Iowa, Maine, Massachusetts, Michigan, Missouri, Nevada, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Texas, British Columbia, Alberta, Manitoba, New Brunswick, Ontario, the Yukon Territories; London, England, Auckland, New Zealand, and in the Cayman Islands.

From 1999 until December of 2012, I was the Principal Instructor for a series of Forensic Video Analysis courses offered by the Law Enforcement & Emergency Services Video Association (LEVA), a non-profit organization that to date had trained more than 3000 law enforcement and private sector video analysts from around the world.

From 2006 until December of 2012, I was the Team Leader for LEVA's Forensic Video Analysis Certification Program.

From 1998 until 2013, I was the Team Leader of LEVA's Curriculum Development Committee, and I continued as an active member of the Committee until 2016.

I have been an active member of LEVA since 1994 and I continue offering instruction in the science of forensic video analysis.

For the last nineteen (19) years, I have been a contract instructor of Forensic Video Analysis and Digital Multimedia Evidence Processing for the Federal Bureau of Investigation (FBI) National Academy in Quantico, VA. I continue to teach all four annual FBINA Sessions.

From 2006 until 2014, I was the Digital Video Advisor to the International Association of Chiefs of Police (IACP) for its In-Car Video project and for its Digital Interview Room Standards project, which are funded by the US Department of Justice (DOJ). These programs are focused specifically on the development of compression standards for improved performance of digital video systems to ensure accurate presentation in court. I am a co-author of the national standards for mobile video recording systems for law enforcement.

From 2004 until 2016 I was an instructor of Forensic Video Analysis at the University of Indianapolis, IN. I provided more than 2900 hours of classroom instruction to video analysts from throughout the world who have attended the university's Digital Multimedia Evidence Processing Lab. Students serve as video analysts, primarily from law enforcement agencies in the US, Canada, the UK, Australia, and Asia. Each of the courses

focused on digital video encoding and analog video engineering principles, and on the application of proper scientific methodologies for processing digital multimedia evidence, including scientific techniques used to determine image timing intervals in order to accurately convert time-lapsed video into real-time video for synchronization of separately recorded video sources.

One of the courses that I taught at the University of Indianapolis is entitled Photographic/Video Comparisons, which focuses on the identification of vehicles, clothing, and weapons captured to digital and analog video recording sources. Vehicle identification examines class and unique characteristics of Questioned Vehicle, and often included headlight spread pattern analysis. Clothing identification examinations often involve comparing fabrics recorded under the influence of infrared illumination. I have conducted fabric analysis examinations throughout North America and other locations, and I have taught extensively on the influences of infrared illumination and its effect on fabrics recorded to video. I taught courses in Photographic/Video Comparisons of vehicles and clothing in Canada at the British Columbia Institute of Technology, in the UK, and in Indianapolis for each of the twenty (20) years from 1998 to 2017. This course is accredited by LEVA, which recognizes the course in its Forensic Video Analysis Certification Program.

A significant element of the Photographic/Video Comparison course material, and of the other courses that I teach, involves the science of Reverse Projection Photogrammetry. Reverse Projection is the scientific process of obtaining accurate measurements and making accurate observations from photographic and video images. Reverse Projection has been used among imaging scientists, investigators, and in US courts regularly for more than forty (40) years as a tool to reproduce crime and accident scenes, in order to conduct measurements and to make other accurate observations.

Each of the courses that I teach focuses on reflection of light, both visual and infrared, pixel tracking, digital compression technology, macroblock analysis, motion vector analysis, color measurement/analysis, speed estimation, and on digital and analog artifact (error) identification for the sole purpose of ensuring accurate interpretation of video evidence. Since each of the signal and digital components could impact the meaning of images, and since there are a significant number of technical variables that could cause a lay person to misinterpret the appearance of video data, the majority of testimony that I have provided includes a narrative explanation of the events captured to the video recording system.

I am a former Police Officer with the City of Vancouver Police Department in Canada where I was assigned to the Criminal Investigation Division as the head of the department's Forensic Video Unit.

Compensation

See attached Fee Schedule

Primary Equipment & Software Used

- Adobe CC
- iNPUT-ACE
- QuickTime Pro 7.7.2

Exhibits

All information, any and all of the underlying foundational or support materials, and/or any portion thereof within this document, or any of its references or attachments, are to be considered important exhibits with regard to this case and this report.

All .mp4 files, PDF files,.JPG files, images, videos, recordings, testing, methods, procedures, etc. are all to be considered exhibits that are hereby fully incorporated, and are an integral part of this report, and may be used at any time during any aspect of proceedings associated with this case, including, but not limited to, deposition and/or trial as exhibits to aid in my testimony or presentation.

In order to attempt to answer the posed questions, I was provided with the following exhibits for my analysis:

Item 1. AXON_Body_2_Video_2020-05-21_2249.mp4

Item 2. AXON_Body_2_Video_2020-05-21_2250.mp4

Item 3. Audit_Log_for_AXON_Body_2_Video_2020-05-21_2249.pdf

Item 4. Audit_Log_for_AXON_Body_2_Video_2020-05-21_2250.pdf

Item 5. Table_of_Contents.xlsx

Item 6. --p0002.jpg

Item 7. --p0035.jpg

Item 8. --p0174.jpg

Item 9. --p0374.jpg

Each of these items was reviewed in detail.

The provided BWC were validated by examining their Hash values with the reported Hash values when they were first uploaded to Evidence.com. As a result of this examination, the provided BWC video clips are the original clips.

AXON_Body_2_Video_2020-05-21_2249.mp4

SHA-256:

CD1FA04EB2850387C1D3ABC418A96AE577456B7468205413AB3E894A74CA7831

Evidence.com Audit

Sha-2:

CD1FA04EB2850387C1D3ABC418A96AE577456B7468205413AB3E894A74CA7831

AXON_Body_2_Video_2020-05-21_2250.mp4

SHA-256:

54FE7996426AED65491FA3A1993C945DD2EB9E153565B4BB7E1B9858FA2D6487

Evidence.com Audit

Sha-2:

54FE7996426AED65491FA3A1993C945DD2EB9E153565B4BB7E1B9858FA2D6487

Technical Considerations

During the examination of the video and audio in this case, careful consideration was given to technical variables that can introduce errors into the image and that could result in the misinterpretation of the images by an untrained observer of compressed video images. Some of the variables that require accurate interpretation include:

- Color values affected by clipping and oversaturation
- Artificial edge patterns that may affect the shape of objects
- Temporal shift in object positioning due to prediction
- Object location and shape adjusted by lens distortion
- Image refresh rates
- Motion blur caused by speed of movement
- GOP structure of images sequences
- AAC audio encoding

Event Timing

The Axon Body 2 camera systems encode H.264 (MPEG4) video streams and AAC audio (Advanced Audio Coding). The video stream incorporates a 15 frame group of pictures (GOP), staring with a reference frame and followed by 14 predictive images (I B B P B B P B B P B B P B B). As a result, the image timing within the GOP is averaged to 33.36 ms between images. However, the audio stream is encoded linearly, providing an accurate record of audio timing. For this reason, the audio timing is used in this report to determine timing between events that can be heard.

The timing provided for the audio record in this report is determined from the analysis of the BWC clip ***AXON_Body_2_Video_2020-05-21_2250.mp4***, which was encoded to Cooke's BWC.

Some of the following timing detail will be repeated in the 'Analysis' section of this report.

- 2:45.396 Ferragamo knocks on the apartment door.

  2:47.285 (Feragamo) "Phoenix Police"

- 2:55.693 – Sounds of door unlocking from inside are heard.

  2:58.680 (Feragamo) "How ya doing?"

  2:58.822 (Whitaker) "What?"

  2:59.241 (Whitaker) "Whoa".

2:59.637 (Feragamo) “Put, Hands”.

2:59.724 – 3:01.275 (Whitaker) “Whoa, Whoa, Whoa, Whoa, Whoa, Whoa, Whoa, Whoa”.

2:59.954 (Feragamo) “Hands, hands, hands”.

3:00.546 (Cooke) “Put your hands down”.

Note that the above communication, starting at 2:58.680 and ending at 3:00.546, occurred in 1.866 seconds, as Whitaker was moving through the threshold of the doorway with a gun in his right hand.

Due to the timing, much of the communication was crosstalk, occurring at the same time.

- 3:01.290 – Shot One
- 3:01.553 – Shot Two (263 ms later)
- 3:01.816 – Shot Three (263 ms later)

All three shots were fired in 526 ms.

Analysis

The two Axon BWC systems were encoded at 29.97 frames per second. Synchronized audio from both systems allowed them to be accurately aligned in order to better assess the events leading up to and during the shooting.

It is important to note that the audio recording is linear and provides a more accurate record of timing. For this reason, timing provide in this report is generated from the audio source of the BWC. Timing from the video sources closely match the audio record.

The attached ***Synchronized Cameras.mp4*** encompasses the twenty-five second event from the time the officers approach the apartment door, through the shots fired event, to the moment a female witness appears at the threshold of the apartment door. The side by side video provides a visual and audio record of the events from the perspectives of the two officers.

The attached ***Camera Perspectives.pdf*** document is provided in order to demonstrate that the perspective of the officers is not precisely reproduced by the BWC.

For example, in Slides 2 through 5, the lens of the Axon camera is located approximately twenty-one inches below the eyes of Officer Cooke. In Slides 6 through 9, the camera worn by Officer Ferragamo is located approximately 18.5” below his eyes.

Due to placement, operation, and data compression, BWC systems are not intended, nor capable, of replicating the experience of the officer.

The attached ***Synchronized Side by Side.pdf*** document provides a detailed image-by-images analysis of the events depicted within the synchronized camera perspectives. Special attention is given to motion blur, which assists in understanding the detailed movements of the officers during specific moments of the event. Motion blur was described in detail in the 'Summary' section of this report.

The ***Synchronized Side by Side.pdf*** document contains slide numbers at the bottom-right corner of each slide for reference purposes.

Slide 2 identifies the location of both officers as they were standing at the apartment door, prior to the appearance of Whitaker. As noted earlier in this report in the 'Event Timing' section, Ferragamo had knocked on the door approximately ten seconds prior to the first images in the ***Synchronized Side by Side.pdf***.

Slide 4 identifies that the object in Ferragamo's left hand is a flashlight. The image on the left, from Cooke's camera, shows the flashlight in Ferragamo's hand. The image on the right, from Ferragamo's camera, shows the end of the flashlight at the left side of the image.

Slides 5 through 17 show the apartment door opening. At slide 9, Ferragamo turns on his flashlight. Slide 17 shows the first image of Whitaker. Cooke is looking directly at Ferragamo. From his camera's perspective, Whitaker cannot be seen.

From slides 21 to 30, Whitaker moves forward, taking a long stride with his left leg.

At approximately slide 30, Ferragamo is heard saying "How ya doing?". The time is 2:58.680.

Cooke's camera does not show Whitaker at this time.

Slide 31 is the first image that shows Whitaker is holding a handgun in his right hand.

Slides 31 to 45 show Whitaker continuing to move through the threshold of the door.

At approximately slide 34, Whitaker is heard saying "What?". The time is 2:58.822.

At slide 45, Ferragamo's right hand begins to move. Whittaker's left hand becomes partially visible in Cooke's camera.

At slide 41, Whitaker's trigger finger is not visible in the area of the trigger guard. At slide 42, his trigger finger appears away from the trigger guard.

At approximately side 46, Whitaker is heard saying "Whoa". The time is 2:59.241.

At slide 46, Ferragamo's camera image becomes blurred due to his sudden and fast movement. From slides 46 through 61, Ferragamo is reaching for his gun with his right hand. As he moves, his body turns slightly to the right, and he begins to bend his chest downward. His movements cause the camera to move quickly down and to the right (as a result, objects within the field of view of the camera move to the left and upward in the image).

Starting at approximately slide 49, Whitaker is heard repeating "Whoa, Whoa, Whoa, Whoa, Whoa, Whoa, Whoa, Whoa". The time is 2:59.724 to 3:01.275 (1.55 seconds). At approximately the same time, Ferragamo is yelling "Hands, hands, hands".

Between slides 49 to 52, Whitaker is moving the gun from the right side of his body, toward his back.

Cooke is not positioned to see the gun in Whitaker's right hand at this time.

Between slides 52 and 61, Ferragamo is pulling upward with his right hand and arm, removing his firearm.

At approximately slide 54, Ferragamo says "Put, hands". The time is 2:59.637.

Slide 62 represents the first moment that the gun is visible to Cooke's camera. The gun is in Whitaker's right hand and is positioned behind his back. Whitaker does not indicate that he is aware that Cooke is standing behind him. Whitaker has placed the gun in a position that is no longer visible to Ferragamo.

Slide 65 shows that Cooke's camera is in motion. Until this moment, Cooke was not reacting physically to the events.

Between slides 65 and 75, Whitaker continues moving through the doorway and toward Ferragamo with the gun behind his back. Ferragamo is moving backward and to his left, putting a wall between himself and the gun in Whitaker's right hand.

Starting at slide 74, through to slide 86, Whitaker moves the gun quickly from behind his back, forward, and to his right side. This movement occurred in just .367 ms.

At approximately Slide 74, Cooke is heard commanding Whitaker "Put your hands down". The time is 3:00.546.

During the movement by Whitaker, Cooke moves forward toward Whitaker, but stops at slide 89. At this moment, Cooke's head is tilted downward. His face is turned in the direction of the gun in Whitaker's right hand.

Between slides 92 and 100, Cooke steps back with his right foot as he draws his firearm. At slide 100, Whitaker is crouched down and his right hand is not visible to either officer.

Between slides 101 and 115, a time of less than ½ a second, Cooke brings his firearm forward toward Whitaker. Whitaker is crouched. His right hand is not visible to Cooke.

Cooke fires the first shot at slide 116, which is 3:01.290 from the beginning of his video recording.

Cooke fires the second shot at slide 123, 3:01.553 from the beginning of his video recording. The shots are 263 ms apart in time. Whitaker's right hand is not visible to either officer.

Slide 126 shows Whitaker's empty right hand for the first time. His right hand is visible to Ferragamo's camera. Cooke is not positioned to see that Whitaker's right hand is empty.

Cooke fires the third shot at slide 131, 3:01.816 from the beginning of his video recording. The third shot occurred 263 ms after the second shot. Whitaker's right hand is not visible to Cooke.

The three shots were fired in 526 ms (approximately ½ a second).

Slide 145 is the first image from Cooke's camera that shows Whitaker's empty right hand.

A female witness is seen at the threshold of the door in Cooke's camera starting at slide 251.

The gun is seen on the ground, inside the threshold of the door between slides 350 and 356.

Opinion

After carefully examining the provided BWC data and the included still images of the officers, I have formed the following opinions:

- Ferragamo knocked on the door and announced their presence.
- Whitaker opened the door approximately twelve seconds later.
- Whitaker advanced out of the door with a gun in his right hand and finger inside the trigger guard.
- Whitaker moved the gun behind his back briefly, before moving it to his right and forward.
- Cooke's first potential observation of the gun was as Whitaker advanced toward Ferragamo, out of the door and with the gun behind his back.
- From the moment the gun in Whitaker's hand was potentially first visible to Cooke, 1.5 seconds elapsed until the first shot was fired.
- The gun was briefly visible to Cooke, but when Whitaker moved the gun from his back to the right, the gun and his hand were no longer visible to Cooke or to Farragamo.
- Approximately 2.3 seconds elapsed from the moment Farragamo reacted to seeing the gun, until the first shot was fired by Cooke.
- Cooke fired three shots in approximately ½ a second.
- During the first shot, Whitaker was holding the gun in his right hand.

This report is true and accurate to a reasonable, or higher, degree of professional certainty and/or probability.

Grant Fredericks