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The Trump Rally Shooting: Listening to an Assassination Attempt

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Popular version of 3pSP10 – Interpreting user-generated recordings from the Trump assassination attempt on July 13, 2024
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Read the abstract at https://eppro01.ativ.me//web/index.php?page=IntHtml&project=ASAFALL24&id=3771549

–The research described in this Acoustics Lay Language Paper may not have yet been peer reviewed–

On Saturday, July 13, 2024, thousands of supporters attended an outdoor rally held by presidential candidate Donald J. Trump at the Butler Farm Show grounds in Butler, Pennsylvania. Shortly after Mr. Trump began speaking, gunshots rang out. Several individuals in the crowd were seriously wounded and killed.

While the gunfire was clearly audible to thousands at the scene—and soon millions online—many significant details of the incident could only be discerned by the science of audio forensic analysis. More than two dozen mobile phone videos from rally attendees provided an unprecedented amount of relevant audio information for quick forensic analysis. Audio forensic science identified a total of ten gunshots: eight shots from a single location later determined to be the perpetrator's perch, and two shots from law enforcement rifles.

In our era of rapid spread of speculative rumors on the internet, the science of audio forensics was critically important in quickly documenting and confirming the actual circumstances from the Trump rally scene.

Where did the shots come from?

Individuals near the stage described hearing pop pop pop noises that they reported to be "small-arms fire." However, scientific audio forensic examination of the audio picked up by the podium microphones immediately revealed that the gunshot sounds were not small-arms fire as the earwitnesses had reported, but instead showed the characteristic sounds of supersonic bullets from a rifle.

When a bullet travels faster than sound, it creates a small sonic boom that moves with the bullet as it travels down range. A microphone near the bullet's path will pick up the "crack" of the bullet passing by, and then a fraction of a second later, the familiar "bang" of the gun's muzzle blast arrives at the microphone (see Figure 1).

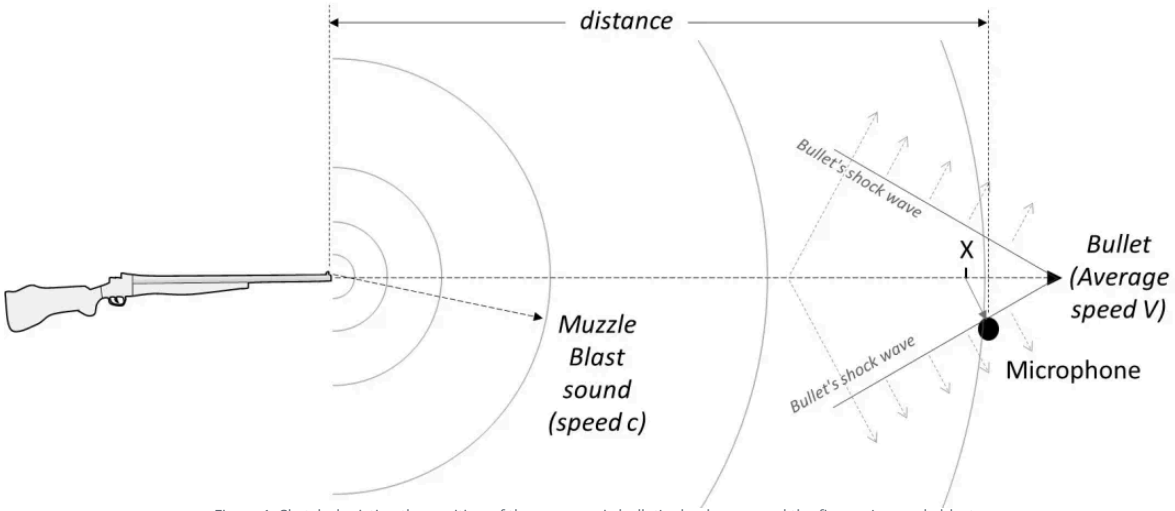

Figure 1: Sketch depicting the position of the supersonic bullet's shock wave and the firearm's muzzle blast.

From the Trump rally, audio forensic analysis of the first audible shots in the podium microphone recording showed the "crack" sound due to the supersonic bullet passing the microphone, followed by the "bang" sound of the firearm's muzzle blast. Only a small fraction of a second separated the "crack" and the "bang" for each audible shot, but the audio forensic measurement of those tiny time intervals (see Figure 2) was sufficient to estimate that the shooter was 130 meters from the microphone—a little more than the length of a football field away. The acoustic calculation prediction was soon confirmed when the body of the presumed perpetrator was found on a nearby rooftop, precisely that distance away from the podium.

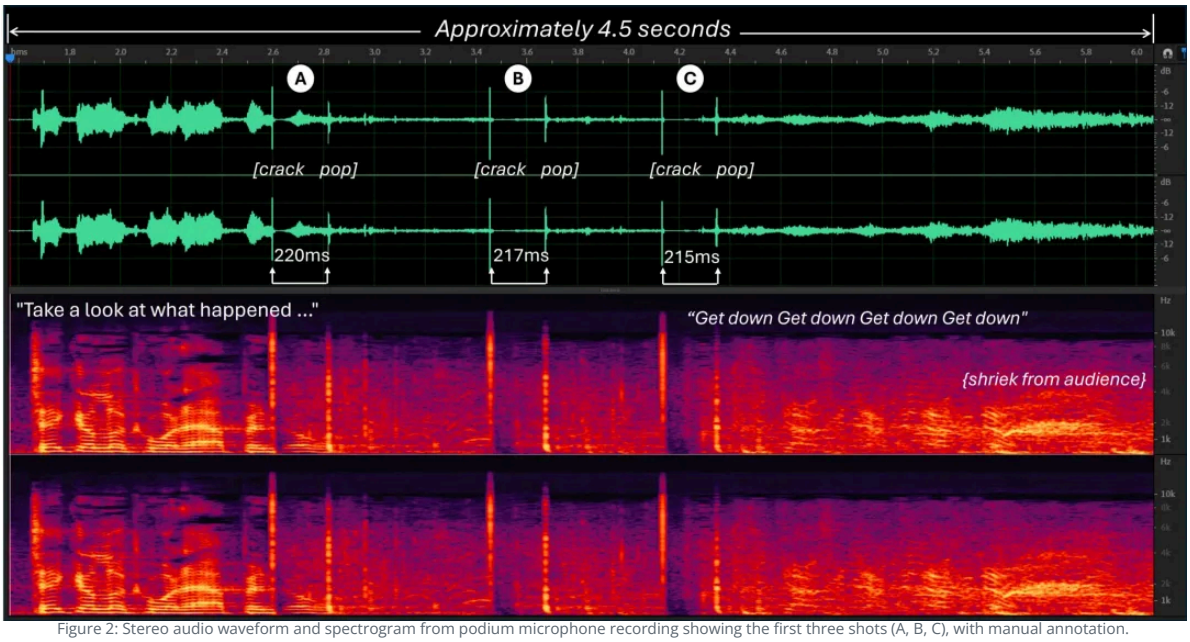

Figure 2: Stereo audio waveform and spectrogram from podium microphone recording showing the first three shots (A, B, C), with manual annotation.

How many shots were fired?

The availability of nearly two dozen video and audio recordings of the gunfire from bystanders at locations all around the venue offered a remarkable audio forensic opportunity, and our audio forensic analysis identified a total of ten gunshots, labeled A-J in Figure 3.

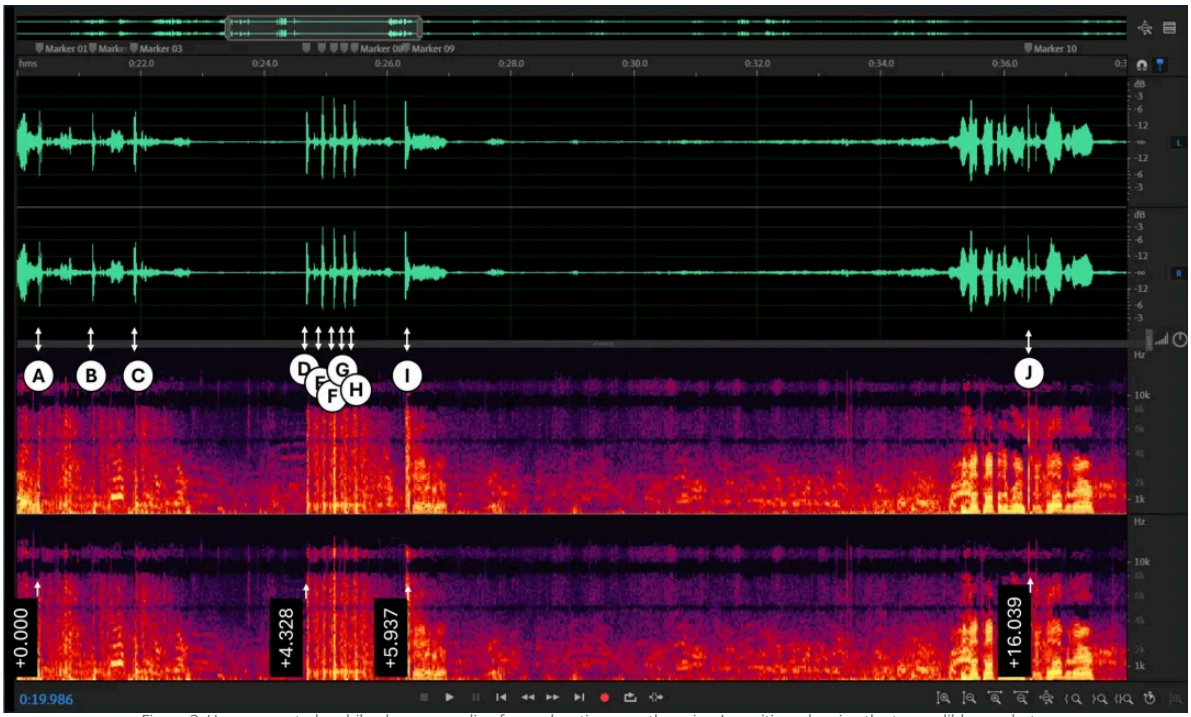

Figure 3: User-generated mobile phone recording from a location near the sniper's position, showing the ten audible gunshots.

The audio forensic analysis revealed that the first eight shots (labeled A-H) came from the identified perpetrator's location, because all the available recordings gave the same time sequence between each of those first eight shots. This audio forensic finding was confirmed later when officials released evidence that eight spent shell casings had been recovered from the perpetrator's location on the rooftop

Comparing the multiple audio recordings, the two additional audible shots (I and J) did not come from the perpetrator's location, but from two different locations. Audio forensic analysis placed shot "I" as coming from a location northeast of the podium. Matching the audio forensic analysis, officials later confirmed that shot "I" came from a law enforcement officer firing toward the perpetrator from the ground northeast of the podium. The final audible shot "J" came from a location south of the podium. Again, consistent with the audio forensic analysis, officials confirmed that shot "J" was the fatal shot at the perpetrator by a Secret Service counter-sniper located on the roof of a building southeast of the podium.

Analysis of sounds from the Trump rally accurately described the location and characteristics of the audible gunfire, and helped limit the spread of rumors and speculation after the incident. While the unique audio forensic viewpoint cannot answer every question, this incident demonstrated that many significant details of timing, sound identification, and geometric orientation can be discerned and documented using the science of audio forensic analysis.

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