D42 3D Computer Photogrammetric Analysis of Multiple Surveillance Cameras Synchronized Into a Single Data Set to Track the Movement of a Vehicle

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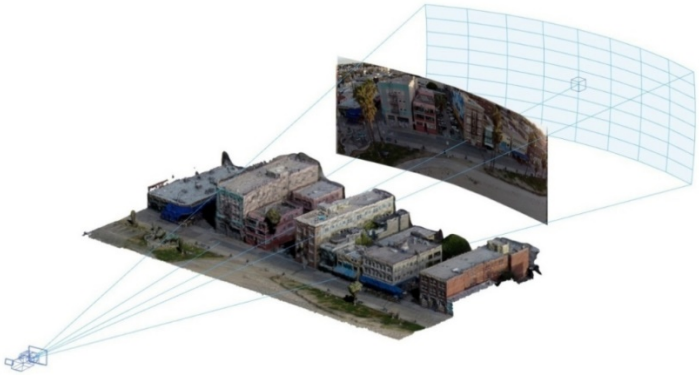
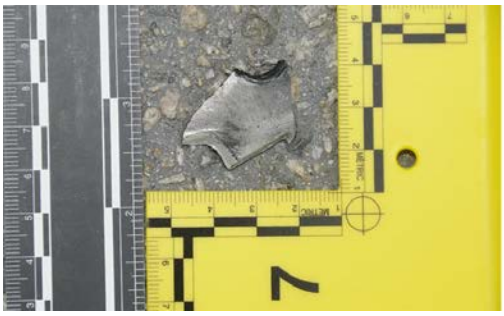
Learning Overview: After attending this presentation, attendees will have learned the process of using a laser scanner, aerial mapping drone, 3D animation software, aerial mapping software, and computer reverse projection photogrammetry to reconstruct the vehicle's velocity and trajectory, which will be discussed.[1] Attendees will understand how the final photogrammetric solution is composited into ground photos and aerial images used to generate accurate exhibits for trial.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by sharing the procedures, equipment, and software used to combine multiple surveillance video sequences into a single 3D computer model for photogrammetric analysis, and from the results create a 3D animation file for trial.

Through the case study of *People v. Nathan Campbell* attendees will learn how photographic evidence, 2D physical evidence diagrams, 3D laser scan data, 3D optical scan data, aerial images, and the footage from multiple surveillance cameras were integrated into a single 3D model for photogrammetric analysis of a vehicle's movement.[1]



On August 3, 2013, a vehicle entered the Venice Beach boardwalk at Dudley Avenue and traveled approximately 600 feet before exiting at Sunset Avenue. The driver, Nathan Campbell, claimed that he accidently put the vehicle into drive entering the Ocean Front Walk. The vehicle struck 17 people, killing 1 person. Mr. Campbell claimed that the vehicle, a 2008 Dodge® Avenger®, had malfunctioned as he repeatedly attempted to stop the car. As the vehicle traveled down the boardwalk striking people and various objects, it generated an extensive debris field. The vehicle's movement and collisions were captured by several shop surveillance cameras located on the boardwalk. Physical evidence such as skid marks, pieces of the vehicle, broken vendor equipment, bicycles, trash cans, blood splatter, and the decedent's body location were valuable bits of information in refining the vehicle's position at those locations.



After reviewing crime scene photos, surveillance video, laser scan data, police reports, and witness statements, a site visit was made. An additional optical scan was conducted by flying an autonomous drone with Pix4D® aerial mapping software. After conduction of a pre-visualization of the crime scene, key vantage points were identified and photographed from the ground and the air. These key images would later be composited into the final 3D

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photogrammetric model for the creation of trial exhibits. The surveillance cameras were located, photographed, and their positions on the buildings measured. The subject vehicle was then photographed, examined, and its dimensions documented for modeling.

Having completed the field work, a 3D wireframe model of the scene and a 3D surface model of the vehicle were developed. At this point, the vehicle surface model, point cloud, and surveillance videos were all imported into 3D Studio Max® for analysis. The virtual cameras were created for each video sequence and positioned in the 3D environment, then the camera was matched to their respective video. Next, the vehicle movement from each video sequence was tracked frame by frame and the 3D vehicle animated to each position. Finally, courtroom trial exhibits were created. Mr. Campbell was sentenced to 42 years to life in state prison.

The process of using a laser scanner, aerial mapping drone, 3D animation software, aerial mapping software, and computer reverse projection photogrammetry to reconstruct the vehicle's velocity and trajectory will be discussed.[2] The attendees will understand how the final photogrammetric solution is composited into ground photos and aerial images used to generate accurate exhibits for trial. Aerial images captured by drones are extremely valuable in that they are capable of capturing large areas that provide a clearer understanding of an event. Attendees will learn how to treat the scene as if it were a Hollywood movie set. Attendees will understand the value of performing a pre-visualization of the scene to capture key ground and air images from select vantage points that will later be camera matched with the final 3D photogrammetric model to create exhibits for trial.

Image resolution and quality are key elements that directly impact the accuracy of the analysis. The benefits of computer-based photogrammetry over traditional modified camera photogrammetry will be made evident.

Reference(s):

1. *People v. Nathan Campbell*. 2d Crim. No. B267280.
2. *SAE Technical Paper Series* 1999-01-0093

Computer Photogrammetry, Aerial Mapping, Laser Scan

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