

# Photogrammetry for Accident Reconstruction with A.V.T Drones

## **Photogrammetry:**

Photogrammetry is a technique that involves capturing and analyzing photographs to extract accurate measurements and create 3D models or point clouds of objects or scenes. It relies on the principles of geometry, optics, and computer vision to reconstruct the three-dimensional structure of the captured subject matter.

## **Understanding the Science Behind Photogrammetry:**

1. **Image Acquisition:** A series of overlapping photographs of the subject or scene are captured from different angles or positions. These photographs should cover the subject comprehensively to ensure accurate reconstruction.
2. **Feature Extraction:** In this step, distinctive features or points are identified and tracked across multiple images. These features could include corners, edges, or other visually identifiable patterns. The software used in photogrammetry algorithms performs feature extraction using techniques such as scale-invariant feature transform (SIFT) or speeded-up robust features (SURF).
3. **Correspondence Matching:** The identified features in each image are matched with their corresponding counterparts in other images. By establishing these correspondences, the software can determine the spatial relationships between the images and the positions of the features in 3D space.
4. **Camera Calibration:** Camera calibration is essential to determine the intrinsic and extrinsic parameters of the camera used to capture the images. It involves estimating the camera's focal length, distortion coefficients, and the relationship between the camera coordinate system and the real-world coordinate system.
5. **Triangulation and 3D Reconstruction:** Using the correspondences and calibrated camera parameters, the software performs triangulation to calculate the 3D position of each feature point. By triangulating multiple points, a 3D point cloud or a 3D model of the scene can be reconstructed.
6. **Point Cloud Processing and Mesh Generation:** The generated point cloud can be further processed to remove outliers, refine the positions of points, and create a denser and more accurate representation of the scene. From the point cloud, a mesh can be generated, representing the surfaces of objects in the scene.

7. **Texture Mapping and Visualization:** The textures from the original photographs can be mapped onto the generated 3D model or mesh, providing a realistic representation of the scene. This enables visualization of the reconstructed object or scene from different perspectives.
8. **Measurement and Analysis:** The reconstructed 3D model or point cloud can be used for accurate measurements, analysis, and simulations. Measurements such as distances, angles, and dimensions can be extracted from the reconstructed data, facilitating detailed analysis and supporting forensic investigations or accident reconstruction.

Overall, photogrammetry combines the principles of image analysis, computer vision, and geometric calculations to reconstruct the 3D structure of objects or scenes from 2D photographs. It is a versatile and powerful technique used in various fields, including archaeology, architecture, surveying, and, in the context of this discussion, accident reconstruction.

### **Why Photogrammetry is Perfect for Attorneys and Accident Reconstructionist.**

Accident reconstruction is a critical component of legal proceedings involving traffic accidents. Incorporating photogrammetry from drones can significantly benefit attorneys and accident reconstructionist by providing accurate and detailed 3D representations of accident scenes. This paper aims to outline the key reasons why attorneys and accident reconstructionist should consider using photogrammetry from drones for accident reconstruction. Additionally, it provides examples of how photogrammetry is utilized in accident reconstruction scenarios.

#### **I. Comprehensive and High-Quality Data Capture:**

- Drones equipped with high-resolution cameras can capture detailed imagery of accident scenes.
- Photogrammetry techniques utilize these images to generate precise 3D point clouds or models of the scene.
- Accurate data capture allows for comprehensive analysis, ensuring vital details are captured and preserved.

**Example:** By analyzing the photogrammetric point cloud, an accident reconstructionist can accurately determine the position and orientation of vehicles involved, the shape of the roadway, and the position of physical evidence such as skid marks or debris.

#### **II. Accurate Measurements and Scene Reconstruction:**

- Photogrammetry allows for accurate measurement of distances, angles, and positions within the accident scene.
- Reconstructionist can extract precise coordinates and dimensions from the photogrammetric data, minimizing estimation errors.

- Accurate measurements contribute to the credibility of accident reconstructions in legal proceedings.

Example: By measuring the precise location of vehicle damage and matching it with the overall scene, a reconstructionist can determine the exact points of impact and the sequence of events leading to the accident.

### III. Virtual Scene Recreation and Visualization:

- Photogrammetry enables the creation of virtual 3D models or point clouds, providing a realistic representation of the accident scene.
- These virtual models can be visualized from various angles, aiding in a comprehensive understanding of the accident dynamics.
- Visualization assists in effectively communicating complex concepts to judges, jurors, and other stakeholders during legal proceedings.

Example: By creating a 3D model from drone-acquired photogrammetry data, an attorney can visually present the accident scene, including vehicle positions, sightlines, and environmental factors, to illustrate their argument and support their case.

### IV. Enhanced Documentation and Preservation of Evidence:

- Photogrammetry allows for the creation of detailed and permanent digital records of accident scenes.
- Precise documentation ensures that critical evidence is accurately preserved, reducing the risk of data loss or misinterpretation over time.
- Access to a comprehensive digital representation of the accident scene facilitates evidence sharing and analysis throughout the legal process.

Example: The accurate digital record created through photogrammetry can serve as a reference for expert witnesses, enabling them to analyze the scene remotely and provide valuable insights into the accident reconstruction.

### V. Simulation and Analysis:

- Photogrammetry data can be used for computer simulations and analysis, providing insights into accident dynamics and alternative scenarios.
- Reconstructionist can simulate vehicle movements, evaluate impact forces, and assess different hypothetical scenarios using the accurate 3D data.
- Simulations based on photogrammetry support the presentation of alternative theories and expert opinions during legal proceedings.

Example: By feeding the photogrammetry data into a physics-based simulation software, a reconstructionist can analyze the impact forces and vehicle behavior, helping determine the feasibility of different accident scenarios.

## VI. Cost and Time Efficiency:

- Utilizing photogrammetry from drones can save time and resources compared to traditional manual scene documentation methods.
- Rapid data capture and processing significantly reduce the time required for on-site measurements and scene documentation.
- Streamlined workflows lead to faster accident reconstructions, benefiting both attorneys and accident reconstructionist.

Example: By leveraging photogrammetry, attorneys can expedite the analysis of accident scenes, gather evidence efficiently, and accelerate the legal proceedings, potentially saving costs

## Conclusion:

Incorporating drones into accident reconstruction processes provides attorneys and accident reconstructionist with a powerful toolset to enhance the accuracy, efficiency, and presentation of their work. Drones equipped with photogrammetry capabilities offer comprehensive data capture, enabling the creation of detailed 3D models and point clouds of accident scenes. Through photogrammetry, accurate measurements, precise scene reconstruction, and virtual visualization can be achieved, facilitating effective communication of complex concepts in legal proceedings. Furthermore, the documentation and preservation of evidence are improved, and simulations based on photogrammetry data support the exploration of alternative scenarios. By leveraging drones and photogrammetry, attorneys, and accident reconstructionist can save time and costs while delivering compelling and robust accident reconstructions, strengthening their arguments, and increasing their chances of successful outcomes in legal proceedings. Embracing this technology is a significant step forward in achieving accurate, dependable, and persuasive accident reconstructions.