

## Laser Scanning for Forensic Investigations

### Overview

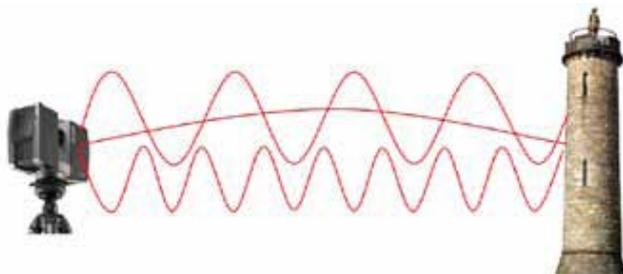
Basic crime scene documentation requires highly detailed accounts of evidence at the scene; however, it can be a challenge for investigators and technicians to document everything given the short window of collection time and the sensitivity of the evidence. The following white paper discusses how 3D laser scanners can be utilized to document crime scenes in a more comprehensive manner compared to traditional tools.

### What is 3D Laser Scanning?

3D laser scanning is the process of capturing millions of data points of a real-world environment (a 3D point cloud), allowing you to view that environment virtually. These point clouds can be used to produce accurate, realistic, 3D computer graphical models for use in a variety of applications including investigations of crime, accident and fire scenes.

### Types of Laser Scanners

There are two main types of large-scale 3D laser scanners available: time-of-flight and phase shift laser scanners. Emitting a single pulse of laser light, time-of-flight laser scanners bounce the light off of an object and measure the time for the reflected light to return to the distance sensor. By timing the roundtrip flight, the distance between the surface of an object and the scanner can be calculated. Typically used in long range scans, time-of-flight scanners capture points at speeds of up to 50,000 points per second. In a phase shift laser scanner, an infrared laser is emitted and reflected back to the system. The distance between the object and the scanner is then calculated by analyzing the phase shifts in the wavelength of the return beam compared to the emitted light. Capable of capturing points at up to 976,000 points per second with an accuracy of +/- 2mm, phaseshift scanners offer higher resolution and faster scans compared to time-of-flight scanners. Advances in the technology have also allowed certain models to be smaller, easier to use, and much more affordable.



### Traditional Evidence Gathering vs. Laser Scanning

Benefits of Laser Scanning in Forensics relevant to their case; what to photograph, what to measure, and what to collect. This typically involves using traditional tools such as tape measures, measuring wheels, still and video cameras, and total stations to capture location images of walls, doors, furniture, and many different kinds of objects. However, given the magnitude of evidence at a scene, and in many scenarios, the cramped space in which a team has to work, this can be an extremely difficult task. Additionally, determining which items are significant in a limited time span can be a challenge – using traditional methods, it can take days to document everything. Often, the relevancy of various artifacts and images are not known until later on in the investigation, at which point, the crime scene may have already been compromised, and measurements are impossible to collect. Replacing traditional crime scene documentation methods, laser scanners offer an innovative approach to processing and documenting a crime scene. Laser scanners can measure and photograph virtually everything at a scene. The data collected by laser scanning solutions are much more accurate and comprehensive compared to data collected with tape measures, sketches, or through single point collection using a total station. For example, in a typical 360° scan of an indoor scene, investigators can collect 10 million points in about 5 minutes – capturing details at the scene down to the millimeter. The speed and compact nature of the laser scanner allows investigators to quickly document entire environments without any subjectivity – everything can be documented in its original position. A permanent record of the scene is captured, and accurate measurements can be calculated using various software programs designed specifically for crime scene analysis long after the crime scene is gone.



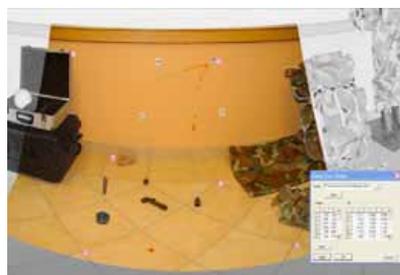
## Benefits of Laser Scanning in Forensics

Many forensic teams have found that the implementation of a laser scanner into their workflow has generated benefits far beyond processing at the scene of a crime. For example, when laser scan data is brought into a software program to register the data points, a photorealistic 3D model can be generated. These models are then used in courtroom presentations to interactively and accurately bring the jury to the crime scene. Creating a full-color walk-through enables attorneys to immerse the jury in the scene and illustrate the paths of people involved in the crime, providing a more compelling argument over simple photographs. Additionally, when a case is brought to trial, it can be months, or even years after the crime was committed. By generating models of the scene using scan data, the scene can be revisited and reexamined at a later date for additional information. The versatility of the device allows for high-resolution documentation of both indoor and outdoor scenes, helping CSI teams to create a more efficient workflow in a shorter timeframe. Setting up in minutes, the scanner accurately captures the detailed dimensions of rooms and environments.

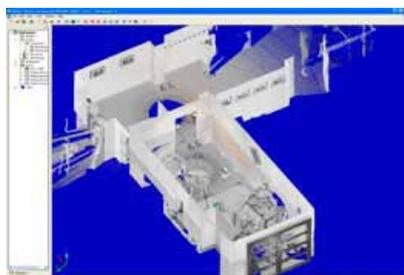


## Real-World Forensic Applications

**Room Visualizations:** Produced from one or more color range data files, color 3D models provide the most realistic view of a scanned scene. Using various software tools, measurements can be collected for any point within the scene.



**Bullet Trajectories:** Adding 3D sight lines to a model for simulation and analysis allows technicians to calculate bullet trajectories.



**Blood Stain Pattern Analysis:** Allowing technicians to work directly with blood stain photos in the 3D model, they are able to produce blood spatter trajectories and view them within the scene.



**Point of View:** Create a viewpoint representing a person, i.e. first responder, at a scene. Interactively demonstrate exactly what was visible from that viewpoint.

## Summary

Providing a comprehensive snapshot of a crime scene, 3D laser scanning improves workflow efficiencies, from the collection of evidence at a scene to post-processing and courtroom presentations for forensic investigations. Used for homicide scenes, traffic accidents, or any other event that either police or private investigators need to document, laser scanning provides a highly accurate, systematic approach to evidence collection.

For more information on the world's smallest, lightest, most affordable 3D laser scanner, visit [www.faro.com/focus](http://www.faro.com/focus).

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