



Seven laser scans were used to capture this crash scene. FARO SCENE software was used to register the data from all the scans into a single point cloud.

Replace Your Total Station with a 3D Laser Scanner

Challenge

Like many police departments, the Knox County Sheriff's Office has been searching for a faster, more effective way to measure crash and crime scenes. With their old total stations, officers could only capture and record one data point at a time, which required many hours to map an entire scene.

Solution

Today, Assistant Chief Bobby Jones, uses a FARO Focus^{3D} laser scanner at crash and crime scenes to gather much more data in a fraction of the time he used to spend aiming and shooting each individual data point.

Results

Chief Jones finds the data and speed of capture of his FARO laser scanner to be completely superior to a total station. He spends significantly less time at each scene and walks away knowing he has captured all the critical data. The FARO Focus^{3D} has forever changed the way Jones approaches a scene - in a good way. He explains, "Scanners are accurate, reliable, efficient, and NOW they are affordable." The two robotic total stations that Knox County Sheriff's Office owns are now stuck in a closet.

Customer Profile



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3D Laser Scanning Vs. Total Station

Over the past 20 years, many crash and crime scene investigators have embraced the total station; a device used by land surveyors to capture distance and slope measurements of individual points. The accuracy and speed of using a total station to take measurements was a huge improvement over tape measures and other manual methods. Suddenly, investigators are putting their old total stations in the closet and adopting a new method of capturing measurements at crash and crime scenes (*Figure 1*). Assistant Chief Bobby Jones, a 30 year veteran of the Knox County Sheriff's Office in Tennessee, is one of those investigators. Chief Jones recently stated, "Scanners are going to become a way of life for all of us investigators. They're accurate, reliable, efficient, and NOW they are affordable." Jones has used total stations to map hundreds, if not thousands, of crash and crime scenes. In 2013, Jones gained access to a FARO® Focus^{3D} laser scanner, and it changed the way he gathers data at crash and crime scenes.

4000 scans and counting

Today, Jones estimates he has taken more than 4000 laser scans, and having a scanner has completely changed his approach to measuring a scene. Jones explains, "With a total station, we have to think about and plan every shot, making evidence preservation and collection totally dependent on the user. Scanners collect the evidence in spite of us. It's given me the opportunity to capture and think about cases in a different way." Jones believes that the FARO Focus^{3D} scanner has all but eliminated the need for using a total station at crash and crime scenes since it offers a more reliable, effective, and efficient method of digital evidence preservation.

One of the advantages of the Focus^{3D} scanner is how quickly it can be set up to begin capturing the scene (*Figure 2*). The scanner is so quick and easy to set up, investigators can use it for all types of crash and crime scenes. According to Jones, "Typically, you can be scanning in less than five minutes. It's literally out of the box, put it on the tripod, hit a couple of buttons, and you are rockin' and rollin'."

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Bobby Jones,
Accident
Reconstructionist



Figure 1. The laser scanner records all the details of a crime scene, like this one, and is much faster than using a total station or manual measurement methods.



Figure 2. Setting up the scanner at a crash site is quick and easy and eliminates the need for a Total Station.



CASE STUDY

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“If you are really interested in being productive and getting the most out of your point cloud data, there is simply no better choice for investigators than CADZone Point Cloud from FARO. It works, it's fast, it's efficient, and it easily handles even the largest point clouds. Many other applications that claim to work with point clouds are just not up to the task of navigating and creating drawings from large, real world, forensic data.”

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The sheer volume of data captured by a laser scanner makes it a superior tool for forensic investigation. The FARO Focus^{3D} laser scanners capture nearly one million points per second with a ranging error of ± 2 mm. When a scan is started, the device turns 180 degrees, capturing data on both sides of the scanner for a complete 360 degree scan, recording a data point for every physical point the laser touches. The Focus^{3D} X 130 has a range of 130 meters and is excellent for scanning indoor spaces and small outdoor scenes. For large, outdoor scenes, the Focus^{3D} X 330 is ideal because of its range of 330 meters.

The data produced by a scanner forms a “point cloud” of these (X,Y,Z) data points that is an accurate digital model of the scene. With proper software, this 3D model can be “walked through” and viewed just like the physical scene. Even small details can be clearly identified in the point cloud and accurate measurements taken to determine the location of evidence, the length of skid and yaw marks, vehicle crush, and so on. An investigator can also use the point cloud to perform point of view studies, blood spatter analysis, and determine bullet trajectories. All the evidence at the scene is digitally preserved by the scanner and it never changes, unlike the scene itself which can change dramatically over time.

Time is of the essence

Jones appreciates that the scanner captures 3D measurements of every point the laser touches, just by pressing a single button. As soon as he arrives at an incident, he likes to immediately set up the scanner in a central location where it can quickly capture the most important data. While it's scanning, he takes photographs and assesses the scene to decide if he needs additional scans to record all the evidence. Sometimes, one scan is all it takes to capture the important evidence. If more scans are required, it is easy to move the scanner, take a new scan, and combine the point cloud data later using FARO SCENE software. The more time Jones has at the scene before it changes, the more scans he will take.

Crash scenes can be highly dynamic, but by starting the scanner quickly, a great deal of data can be captured before any changes have occurred (Figure 3). Jones explains, “Imagine a large crash scene. It's much harder to lock it down and control the investigation than in a typical crime scene. There will be people moving through it, vehicles may be hauled off so the road can be opened. By the time we could get set up and shoot this with a total station, this dynamic scene will have changed. It may even change enough to get some of the evidence we present excluded from court, especially if photographs show that evidence was moved or changed. Efficiency and speed are the keys to preserving evidence and laser scanners can provide us with both.”



Figure 3. Setting up and starting the scanner quickly, a great deal of data can be captured before any changes have occurred



3D Laser Scanning Vs. Total Station

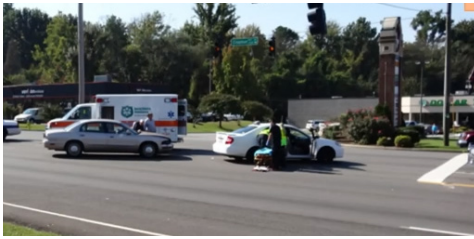


Figure 4. At 11:04 a.m., Assistant Chief Jones arrives and immediately starts scanning this injury crash scene.

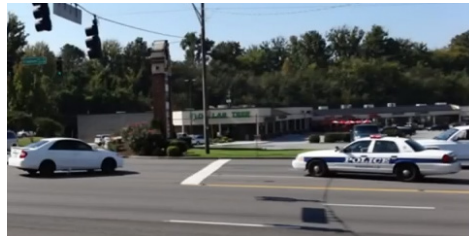


Figure 5. By 11:15 a.m., one of the involved vehicles has been driven away, completely changing the scene. Jones comments, "While the scanner is working, capturing my measurements, I'm taking photos and making notes. I'm not wasting any time."

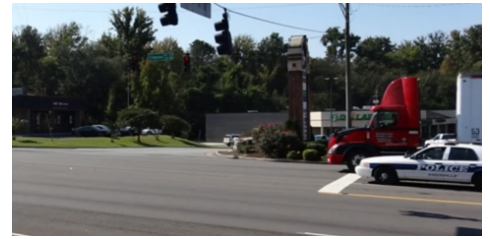


Figure 6. After just 33 minutes (11:37 a.m.), the second vehicle has been towed away. The evidence is gone from the scene, but the laser scanner has captured all the measurement data Jones needs for his investigation.

Jones illustrates this point by describing the timeline of a typical, injury (non-fatality), crash scene he investigated. He arrived at the scene at 11:04 a.m., *Figure 4*, and promptly sets up the FARO Focus^{3D} scanner to take a centralized scan of the crash. By 11:15 a.m., *Figure 5*, the scene has already changed dramatically since one of the vehicles has been removed. At 11:37a.m., *Figure 6*, a tow truck has removed the second vehicle and the scene is completely cleared. Jones commented, "Just 33 minutes after I arrived, the evidence from this crash was gone forever. The scene is changing every second. Getting the scanner up and running as soon as you arrive is critical to evidence preservation."

FARO software used to create diagrams from point cloud data

The laser scanner captures large volumes of data points of the scene, but law enforcement investigators need more than just the raw data to complete their case. FARO has software applications specifically developed for law enforcement investigators who need to create 2D diagrams, 3D diagrams, and animations from point clouds. These software applications allow investigators to obtain critical measurements from the point cloud, analyze the scene, and create compelling exhibits that are ideal for courtroom presentations.

At the crash scene described above, Jones quickly took a grey-scale scan of the scene, knowing he could analyze the point cloud later from the comfort of his office. This single scan captured the final resting positions of both vehicles, along with skid marks and debris. While Jones appreciates the ability of the scanner to take color photographs, when the scene is changing, it's much faster to get the data points without photographs.



Figure 7. A little more than an hour after arriving at the crash site, Jones' analysis and diagram are complete.

Jones used FARO's Crash Zone software, with the CADZone Point Cloud module, to create an accurate diagram from the point cloud. "I opened the point cloud in Crash Zone, traced the lines (shown in *Figure 7*), placed the cars as symbols, added text, and placed dimensions. I placed a satellite image under the point cloud to fill in any missing street lines. By 12:15 p.m., my drawing is complete and ready to turn in."

"Typically, you can be scanning in less than five minutes. It's literally out of the box, put it on the tripod, hit a couple of buttons, and you are rockin' and rollin'!"

Bobby Jones,
Accident
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“The scanner can ‘see’ very well in the dark. Your camera cannot. When scanning in low light, turn the camera off and use grayscale. You will be very pleased with the data you can capture in the dark.”

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The CADZone Point Cloud module can be added to either Crash Zone or Crime Zone. The module includes a number of features for using point clouds to create diagrams, finding and selecting specific points in a point cloud, and navigating through the 3D space of a point cloud. It's not just for 3D modeling-CADZone Point Cloud has many features that speed up the process of creating 2D diagrams from point cloud data and help the user confirm they are selecting the correct points. The point cloud and the 2D diagram can be displayed side-by-side so the user sees exactly how the 2D diagram looks at each step of the drawing process.

Over the years, Jones has used Crash Zone (with the CADZone Point Cloud module) to create many diagrams that he has presented in the courtroom. He describes this software as a surgical tool made for creating forensic diagrams. “If you are really interested in being productive and getting the most out of your point cloud data, there is simply no better choice for investigators than CADZone Point Cloud from FARO. It works, it's fast, it's efficient, and it easily handles even the largest point clouds. Many other applications that claim to work with point clouds are just not up to the task of navigating and creating drawings from large, real world, forensic data.”

Grayscale scans for night scenes

Investigators know that crashes and crimes don't just happen during the day. Another advantage of the FARO Focus^{3D} is its ability to work perfectly in complete darkness. While the Focus^{3D} scanner has an integrated camera that takes high-resolution, color photographs, that option can be turned off when scanning at night; see the comparison in *Figure 8*. Scans will take less time to complete and the resulting grayscale point cloud will contain stunning details of the scene.

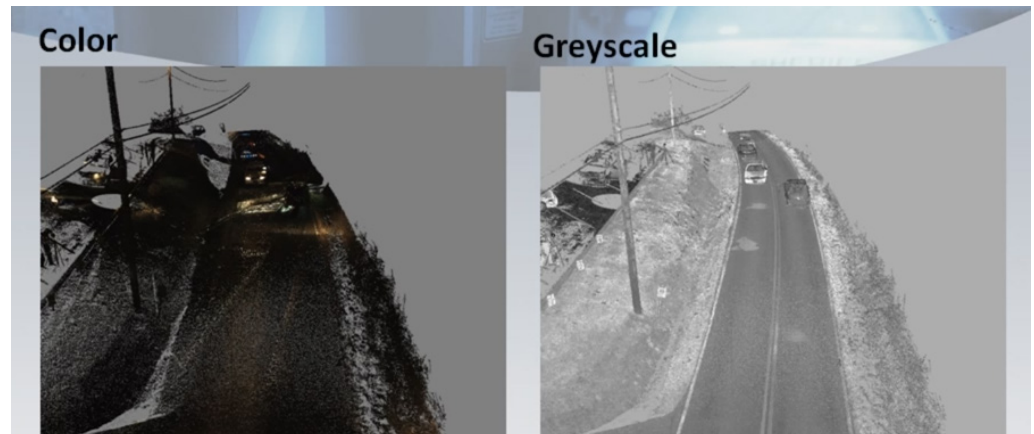


Figure 8. For crashes at night, Jones turns off the integrated camera and does capture grayscale scans. He said, “The scanner can ‘see’ very well in the dark. Your camera cannot.”

Jones states, “The scanner can ‘see’ very well in the dark. Your camera cannot. When scanning in low light, turn the camera off and use grayscale. You will be very pleased with the data you can capture in the dark.” Jones will also use grayscale scans to capture a crash scene that is dynamic, so he can capture as much data as possible before the scene changes. He gets the scanner working as soon as he arrives at a scene, to quickly capture a grayscale point cloud. While it is scanning, he takes his own photographs with a separate camera.



CASE STUDY

3D Laser Scanning Vs. Total Station

When Jones first scanned a scene at night, he thought the point cloud was not going to provide much useful data. This crash involved an SUV and a bicycle, and Jones scanned it using the Focus^{3D}'s color photograph option.

The Night Vision tool in CADZone Point Cloud module made it possible for Jones to see the details in his nighttime scan with surprising clarity.

Night Vision and other features in CADZone Point Cloud module change how the point cloud is displayed on the screen, such as changing the density and size of the points, and even completely hiding points. However, the original points in the point cloud are never actually modified, only the way they are displayed by the software. CADZone Point Cloud module treats the original, scanned, data like evidence and the points cannot be changed or deleted. When a user creates a diagram by adding lines, curves, text and symbols, the drawing is saved as a separate file so the original data is not modified.

About Bobby Jones

Not only is Bobby Jones an Assistant Chief with the Knox County Sheriff's Office, he also provides private, crash reconstruction expert services, including vehicle damage analysis and 3D forensic animation. Through his training services, Jones has taught thousands of investigators to use total stations for forensic mapping and the use of various forensic diagramming and animation software applications. More recently, Jones is getting plenty of requests to train police officers in how to capture crash and crime scenes with a FARO Focus^{3D} laser scanner.

Chief Jones shared his story at the Forensic Scene Mapping conferences, sponsored by the PPI Group. One attendee at this conference asked Jones if he ever still used a total station. Jones response was, "A total station, what's that? I have two robotic total stations that I have not used since I started scanning."

You can hear Jones, entire presentation about his experiences with laser scanning at:

<http://www.faro.com/en-us/faro-zone-and-ppi-seminars>

To learn more about Bobby Jones Accident Reconstruction Services, please visit: **<http://www.reconstructionist.com/>**

"Scanners are going to become a way of life for all of us investigators. They're accurate, reliable, efficient, and NOW they are affordable."

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View more of FARO's case studies at www.faro.com