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Event Data to Autonomous Vehicle Technology - Where We Are… Where We're Going

To View Your Case in 3-D, Collect Your Data in 3-D The Use of High-Definition Surveying in the Evaluation of Case Issues

Introduction:

We live in a three-dimensional world. Technology has brought three-dimensions into the entertainment world through state-of-the-art, realistic computer games and 3-D movies. The realism of the three-dimensions is enhanced by the ever increasing quality of the computer and television screens. The entertainment world has fostered an expectation in people that they will routinely be able to view almost all aspects of their lives on high quality screens and in three-dimensions. Transitioning to the world of litigation, it would be reasonable that decision-makers, judges, and juries would have that same expectation. Available technology has allowed engineers and others to meet that expectation. Through the use of high-definition surveying (HDS) laser scanners, engineers can help people view their case in three-dimensions simply by collecting the data in three-dimensions.

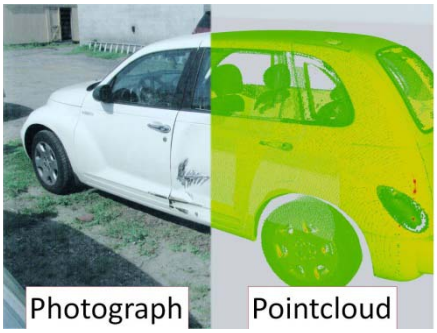
What is HDS Laser Scanning:

HDS laser scanners are pulse-based scanners, also known as time-of-flight scanners, which are based on the simple concept that the speed of light is precisely known. Therefore, the scanner can determine how long a laser takes to reach an object and reflect back to a sensor, and thereby can calculate how far away that object is located from the scanner. This process is repeated millions of times to rapidly capture shapes of objects in its path such as buildings, vehicles and landscapes. The process of 3-D scanning is also referred to as LIDAR. Although widely considered to be an acronym of Light Detection and Ranging, the term LIDAR was actually created as a portmanteau of "light" and "radar". In very basic terms, high-definition surveying [HDS] laser scanning is the next generation of accurate, fast, comprehensive data collection. Classic total-station survey equipment collects data points one at a time, while the HDS laser scanners collect millions of data points in just minutes. The dense "point cloud" data collected by the laser scanner creates an accurate, three-dimensional model of everything that the beam reflects off of. The two most common types of scanners utilized in the

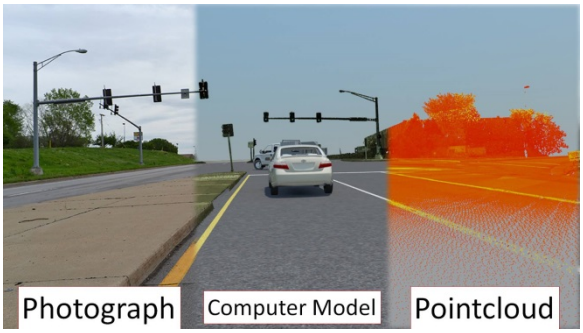
industry are short-range scanners, typically utilized for a focal distance of less than 1 meter, and mid and long-range scanners, typically utilized for a focal distance of greater than 2 meters. A single scan with some long range scanners can record reliable data, accurate to within 0.25 inches, up to about 300 feet away.

HDS laser scanning is utilized for any application that requires accurate preservation of 3-D data. Examples include land surveying; the documentation of buildings and facilities that no longer have accurate blue prints for use in maintenance, repair and additional construction; and historical preservation purposes. In the forensic area, the uses of HDS laser scanning are as varied as the type of cases. Forensic uses of HDS laser scanning includes documenting objects the size of skyscrapers to those smaller than footprints. Long-range scanners are effective in expeditiously and accurately collecting data from buildings, bridges and roadways, among other large objects. Mid-range scanners are useful for scanning medium-sized objects like vehicles and machinery. Their effective range is approximately 50 feet. Close range scanners are utilized when you need to record finer details in objects such as tire tread marks or footprints. The decision relative to which kind of scanner to utilize is often times a balance of detail versus the volume of data versus the time available to scan. In forensic work, the investigator often has a limited amount of time in which to collect data. As such, the selection of the proper scanner may be critical in accurately collecting the most comprehensive data over the shortest amount of time. Selecting a company that offers several different scanning options could be an important factor in getting the best data under the available circumstances.

<u>Utilizing HDS Laser Scanning in Forensic Investigation and Analysis</u>:



Think of the progress the forensic industry has made in the collection of data when investigating any type of “event” that might be the subject of potential litigation. In the early years, investigators “paced” off "*selected*" distances to obtain estimated measurements. Then, investigators collected "*selected*" data using tape measures and levels in combination with photographs. The next generation was the ability to collect data in 3-D using total-station survey equipment which allowed the investigator to take "*selected*" individual measurements through the use of a transit and prism. Again, it was up to the investigator to "*decide*" which points to collect with the survey equipment and follow with selected photographs. Today, the HDS laser scanner not only takes significantly more data points than any other method, the use of the laser scanner takes the “*selection*” process (of what data to collect) out of the mix. The scanner will collect data indiscriminately off of any surface that the laser beam will reflect. The ability to collect such comprehensive 3-D data in a relatively short amount of time provides an unprecedented amount of accurate and detailed data, without having to “think” about what to collect and not collect. This is critical in that many times the investigator collecting the data will not readily know or understand the potentially complex issues of the event. The ability to simply document all of the data available is invaluable to those who eventually anaylize the data. Another important aspect of 3-D scan data is the fact that you are able to use the raw "point cloud" data models of vehicles long after the vehicles are no longer available, and/or you are able to analyze roadways and sight lines even if the roadway and surrounding features have changed since the time of the incident. Accurate three-dimensional field data can be utilized in place of expensive and time-consuming "scene" recreations.



In this age of “Daubert” [*Daubert v. Merrell Dow Pharmaceuticals,* 509 <u>U.S.</u> <u>579</u> (1993)] any attorney, insurance professional or expert needs to be able to prove that the technology is not only accurate but accepted in the industry. If this were five years ago, the tone of these next few paragraphs might be a bit more

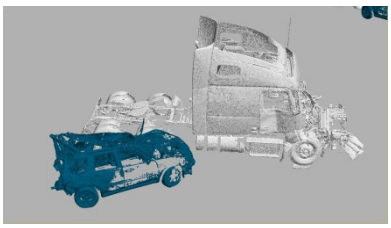
detailed. However, the acceptance of HDS point cloud data has increased exponentially over the years. Over the 14 years this author has been utilizing laser scanners, we have never encountered a situation where the data was not admitted into evidence. That said, one needs to understand that the acceptance by the court should never be taken for granted. Each “gate keeper” has a different level of sophistication and experience, and the assumption needs to be that you have to prove the process each and every time. The acceptance starts from the very beginning, with the procurement of any “white papers” that shows testing by independent organizations such as research centers or universities that support the overall accuracy of the equipment. The equipment needs to have the proper and current “calibration certificates” from the manufacturer. There needs to be internal checks in each scan that allows the service provider the ability to show that the scans in question are accurate. This is typically completed by placing known measurements (machined targets) within the scan that can be checked for accuracy when the data is processed. Finally, if you can show the court that the scanner is “typically” used in other accepted areas of science, that aids in the decision making process.

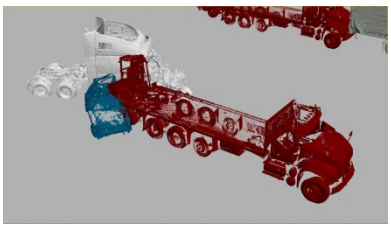
HDS laser scanning provides the ability to create quickly, and most importantly with unprecedented accuracy, a 3-D environment in which to view an event. Additionally, the accurate, to-scale 3-D environment can (and is) utilized as the palate on which the scientific/engineering analysis can be performed and ultimately shown to those involved in the matter- from the adjusters, to the attorneys, to the experts, to the opposing side, and to the Trier-of-Fact. When multiple experts are involved on a case, the 3-D environment can be utilized as “data” that expert(s) can share as part of their analysis process. This reinforces that all the experts working on the file are utilizing the same, accurate data. Properly captured scan data is reliable in that not only is it accurate, but the data points cannot be manipulated within the environment. During the analysis process, relative distances, sight distances, witness views, and other spatial relationships can be quickly and easily evaluated. This is helpful in evaluating the credibility of testimony, i.e., "could they see what they say they saw"? The point could data can be correlated to actual photographs and/or be utilized to create accurate, realistic animations.

Utilizing Laser Scanning in the Analysis of Vehicular Collisions:

Examples of the use of HDS laser scanning include basic data collection for the analysis of motor vehicle collision scans. By quickly and accurately collecting three-dimensional data of the roadway, the surrounding features of the roadway, and the vehicles involved in the collision, engineers can accurately evaluate, in three-dimensions, how a collision occurred as well show what it is that the involved parties and/or witnesses should have seen. It is important to note that most of the time the engineering analysis utilizes the raw point cloud. The ability to use the raw data make the use of the HDS laser scanner that much more efficient and economical.

Oftentimes an integral piece of a crash analysis is the vehicle damage profile. It is often difficult to tell from a visual inspection how vehicles interact with each other during a crash. Accurate three-dimensional scan data of the vehicle allows the ability to view the damage profiles in a 3-D space or "world". The 3-D vehicles can be positioned, like a jigsaw puzzle, to illustrate how they were aligned to each other at the point of impact. A classic example was a multi-vehicle collision where a critical issue in the case was the order and specific angle in which the collisions occurred. The ability to take 3-D scans of the vehicles early on in the case provided the engineers with detailed measurements from which accurate computer models could quickly (and accurately) be created. By moving the 3-D models around in the 3-D "world", created by the scan data, accurate angles of impact could be defined. Since the laws of physics dictate that the vehicles will move based on the angle at which they are contacted, the engineers were then able to tie in the defined post-impact movements with other physical evidence (much of

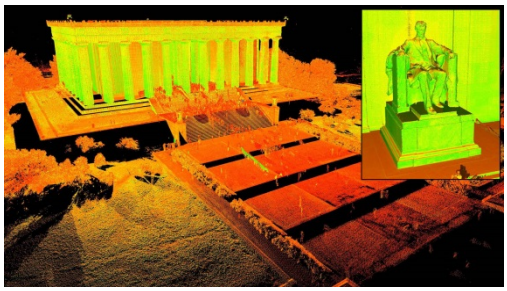




which was captured at the site through 3-D scans) to piece together the collision sequence that was consistent with the vehicle data, roadway data and applicable laws of physics.

The accurate 3-D environments, quickly created by proper laser scanning, also provides the engineer the ability to demonstrate what people within that environment could see. When an issue becomes the question of what a vehicle operator or a witness could or should have seen, the 3-D environment created by scan data becomes a very powerful (and accurate) tool to evaluate multiple theories in a short period of time without the need to complete complicated and potentially expense testing at the site.

Another typical use of 3-D scan data is in the process of obtaining measurements from two-dimensional photographs and video. Photographs and/or individual frames from video are matched to the specific location within the accurate three-dimensional environment captured by the HDS laser scanner. The engineer can then move around within the environment to collect measurements otherwise not available. These techniques are extremely useful in vehicular collisions when the point of rest of vehicles or debris/tire marks were not measured at the scene but appear in photographs or video captured by others.



Other Uses of Laser Scanning:

Digital historical preservation is a growing area where 3-D scanning is utilized. This office recently donated its services, completing a joint project with CyArk (a historical preservation nonprofit company) and the National Park Service, in which HDS laser scanners were utilized to collect three-dimensional measurements to digitally preserve the Lincoln Memorial in Washington, D.C. Over the course of 4 days, over 600 scans were completed collecting almost 4 billion data points allowing for the creation of, for historical preservation purposes, an accurate 3-D model of the complete interior and exterior of this national treasure. The same processes, procedures and attention to detail and accuracy utilized in the forensic area were utilized for this historic project.

What Does It Cost?

The actual cost of HDS laser scanning can depend heavily on the service provider utilized. While the cost of the actual scanning equipment has steadily come down in price (due to the advances in technology), scanners are not inexpensive. If your service providers are scanning “veterans”, their knowledge of the equipment, their experience in the most efficient manner to collect the data in the field, and perhaps most important, their ability to quickly and accurately process the data could be significantly less than employing scanning “novices”. The actual process of setting up the scanner and turning it on is reasonably straight-forward. However, the increase in cost when hiring “novices” comes from unnecessary work due to lack of proper planning resulting in unnecessary time spent in the field or incomplete field data; not utilizing the most up-to- date software resulting in increased processing time; and performing unnecessary tasks prior to determining whether the case warrants the additional expense of time. When you select the proper company, a 3-D scan should be around the same price as hiring a surveyor to complete the project (using classic total-station survey equipment), but the data will be significantly more robust. There are companies that provide the ability to only scan; there are companies that provide the ability to only process the data; and there are companies that can do both.

Conclusion:

HDS laser scanning technology is available for use in all types of cases, large and small. If you want to view your case in three-dimensions, have your data collected in three-dimensions. The technology is available, the expertise to utilize the technology is available, the process to collect the data is efficient, the data collected is accurate, and the entire process is cost-effective.