3D Scanning

A New Weapon in the

By Quentin F. Urquhart, Jr. and John E. Swanson

Trial exhibits made by 3D-scanning technology have established a new standard for accurately documenting and displaying evidence.

You are defending a product liability case involving a portable light tower that unexpectedly fell on a highway construction worker. The plaintiff claims that the accident was the result of a defect in the tower's winch mechanism,

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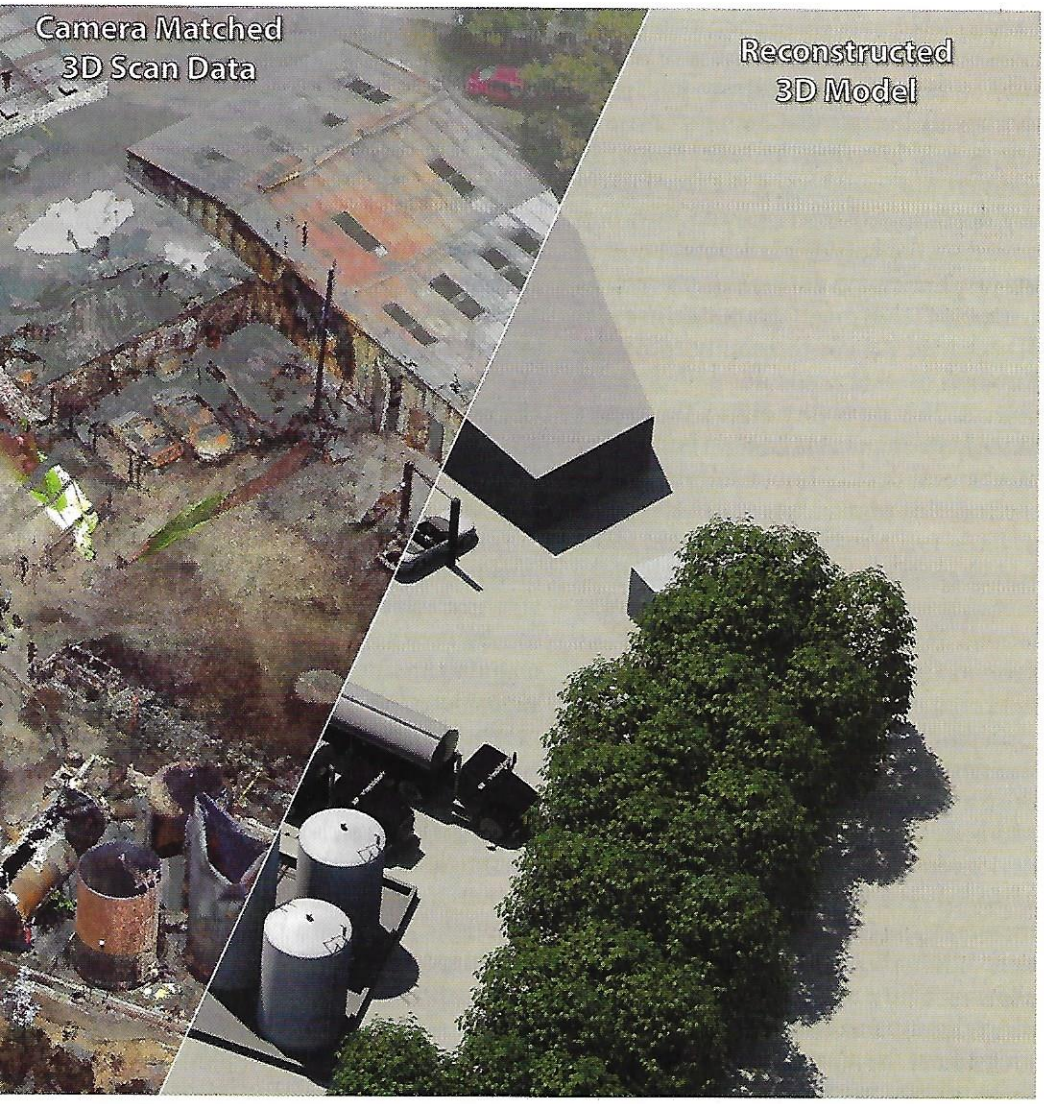
Trial Lawyer's Arsenal



which allowed the tower boom suddenly to rotate downward. A major element of your defense will be to demonstrate that the alleged "defect" in the winch played no operative role in raising or lowering the tower, and thus its purported failure could not have caused the accident. To prove this fact, the jury must thoroughly understand the mechanical operation of the light tower and, in particular, how the winch braking mechanism functions.

Traditionally, you might address this challenge through the use of photographs or other illustrations depicting the key parts of the tower. You could also consider bringing an exemplar light tower to the courthouse for a live demonstration, but that carries with it significant logistical issues and the risk that something might go wrong during your presentation: vivid memories of the O.J. Simpson glove debacle dance in your head. Last, you realize that the location of the winch deep within the tower unit will inhibit an effective demonstration of its operation to the jury.

A potential solution to your dilemma would be to hire a graphics consultant to create a series of computer-based animations depicting various aspects of the tower's operation. However, you know from experience that the process of taking measurements and translating them into realistic animations can be time-consuming and expensive. Furthermore, even after all this effort, you may be prevented from using the animations at trial on the grounds that they were not "to scale" or did not "precisely replicate" how the tower functions. In discussing these issues with your expert engineer, he or she makes you aware that a new technology called 3D scanning can solve virtually all of your problems.

What Is 3D Scanning?

3D scanning refers to the capture and digital replication of real-world geometries or shapes in 3D space using any number of available technologies. Commonly used as a tool for surveying buildings, terrain, and other architectural features, 3D scanning is now being used to create incredibly accurate and compelling trial presentations. The most common types of 3D scanning that lawyers and their experts use are terrestrial scanning and hand-held scanning.

In terrestrial scanning, a computerized scanner is mounted on a tripod and uses a laser to scan a specified area thousands of times per second as it pans across the scene. As each laser pulse is emitted, the scanner measures the time that it takes for the laser to return, and with the known speed of light, the scanner can determine the distance to the surface measured. Because terrestrial scanning is performed from a fixed position, multiple scans of the subject area are usually taken from various positions using designated reference points to fill in the blind spots, or "shadows." The "point cloud" data generated by the various scans is then combined with photography to create highly accurate, photorealistic 3D models of the scene. Terrestrial scanners are typically accurate to within millimeters and are especially well suited to imaging accident sites, buildings, and vehicles.

Hand-held scanning generates similar data to terrestrial scanning data but instead of the scanner being mounted on a tripod, the operator holds the scanner in his or her hand and scans an object while moving around it. The most common hand-held scanning technology uses a combination of depth sensors and cameras to triangulate distance, track the scanner's position in real-time, and achieve accuracy to within a millimeter. Whereas a terrestrial scanner's line of sight is based on a fixed position per scan, hand-held scanners fill in shadows by capturing data

while on the move, collecting hundreds or even thousands of frames of data in a single scan. Hand-held scanning is often used to image mechanical devices, sections of larger objects, tight spaces, or very small objects. Moreover, hand-held scanning data can be combined with terrestrial point cloud data to create seamless 3D models of entire accident scenes.

One of the most dramatic uses of 3D-scanned data is the ability to do fly-throughs of what would normally be solid objects. This capability allows the viewer to see key components inside a building or mechanical device.

A key attribute of 3D-scanned images is their ability always to remain in proportion no matter how the images are manipulated. With traditional site investigations, forensic engineers might take hundreds of photographs and then attempt to piece them together to recreate the conditions in the field. With 3D scanning, however, all of the spatial relationships are preserved exactly as they appear in real life. This makes it possible to zoom in or out on a particular object without ever losing "scale."

Applications of 3D-Scanned Data

Once you have collected the 3D-scanned data, you can then use it in a variety of ways to demonstrate key points effectively at trial. 3D images allow you to view, pan, zoom, measure, and mark up point cloud data right before a jury as if you are "inside" a three-dimensional photograph.

Working with a graphics professional, you can create 3D models of objects and place them on virtual "turntables" so that they can be viewed from any angle. In our construction accident case, this would allow you to move 360 degrees around the light tower while highlighting each key component—boom, lights, winch, crank handle, cable, and locking pin, among others. This technique would also give you (or your witness) the opportunity to explain thoroughly the role that each part plays in raising and lowering the tower boom. In addition, you could bring the locations of key operating instructions and warnings posted on the outside of the light tower to the jury's attention during this process.

One of the most dramatic uses of 3D-scanned data is the ability to do fly-throughs of what would normally be solid objects. This capability allows the viewer to see key components inside a building or mechanical device. In our ongoing hypothetical, this would allow you to start with a "birds-eye" view outside the light tower and then "fly" inside to show the jury precisely where the winch mechanism is located. Next, you could isolate and place the winch on a virtual turntable to highlight each of its key components.

In product cases, it may be important to demonstrate the various pieces that comprise a given component part. Using 3D-scanned data, the key pieces of a mechanical device can be virtually disassembled in an exploded view, highlighted as needed, and then reassembled to their original condition. While there will always be value in allowing a jury to see and physically handle real component parts at trial, 3D scanning allows the jurors to see precisely how those parts fit together.

Utilizing the available software, you can also use 3D data to create animations showing the physical movement of objects. In an automobile accident case, your expert can use 3D data to illustrate the paths of the involved vehicles up to and including the point of impact. 3D data can also illustrate the movement of chemicals through an industrial facility to show how they contributed to an explosion. In our construction accident case, a 3D-scanned animation can demonstrate the raising and lowering of the tower boom without any fear that something unexpected might take place. Further, the movement of the various gears and other components within the winch can be illustrated to show how they interact with each other. This animation can then be repeated in slow-motion to allow the jury to see precisely how the winch braking system disengages when the tower is being lowered.

3D-scanned data can also effectively place a jury into the "driver's seat" by providing the jurors with the same point of view as the involved parties. Thus, in an automobile accident case, a jury would be able to understand exactly what a driver was able to see (and for how long) before a collision took place. Or you could use 3D-scanned data to demonstrate that a person who claims to have been a witness to an accident could not have seen it from his or her vantage point. In a premises liability case, you can use 3D data to allow a jury to experience walking down the aisle of a store in almost exactly the same manner as a plaintiff.

Another important feature of 3D scanning is that it allows precise comparisons with exemplar products. 3D-scanned data can be used to show that a product was manufactured to original specification by superimposing a scan from the subject product on top of an exemplar product. 3D scanning can also demonstrate how a product has been altered or abused by bringing to light scratches and gouge marks that might not be obvious on initial examination. Using these same techniques, 3D scanning can verify a point of impact by matching an area of deformation on one object with the precise contours found on another object.

Finally, 3D-scanned data can create 3D-printed objects. 3D printing utilizes an additive process to build a model from a digital file made with a 3D scanner. 3D printers can be used to create "to-scale" reproductions of rooms, buildings, vehicles, mechanical parts, and even entire accident scenes. Unlike traditional construction methods that focus on the creation of a single model for use during a trial, the 3D-printing process can be repeated over and over again until a satisfactory model has been achieved.

Benefits of 3D Scanning

3D scanning offers a multitude of advantages over traditional methods of gathering evidence and presenting it during trials. The most obvious is the accuracy with which it preserves evidence. As pre-

viously noted, 3D data from terrestrial and hand-held scanners is typically accurate to less than an inch, making it by far the most precise method of measurement available. The scanned data results in a highly redundant, permanent resource that can be referenced whenever needed without having to return physically to an accident scene.

Another important attribute of 3D scanning is speed. While conventional evidence gathering techniques may take many hours (or even days) to complete, a 3D scanner can collect millions of highly accurate data points in just minutes. Gathering evidence using 3D scanning is also safe because it captures evidence using non-contact means. No longer do you or your investigator need to wade out into traffic at a busy intersection or along a heavily travelled roadway to photograph and measure key elements. The 3D scanner can be set up on the side of the road and can accurately scan everything in its field of view even if traffic is moving through the area.

Perhaps the most significant benefit of 3D scanning is its objectivity. In a conventional forensic examination, photographs and measurements are taken based on subjective decisions about what the investigator thinks is important *at that time*. These decisions, however, may ultimately result in a less than optimal data set. With a 3D scanner, significantly more subjectivity is removed; the scanner impartially collects thousands of measurements per second on everything within its range and line of sight. If a new mechanism of causation is proposed years after the evidence was originally collected, your expert could confidently reanalyze the 3D-scanned data and extract survey-quality measurements to test the validity of the new theory.

3D scanning is relatively economical. The cost to conduct a typical scan and perform post-processing of the data by a qualified scanning expert may be as little as $2,500. Once that scan has been obtained, you can then decide what kinds of trial exhibits or animations you want to create using the data. The cost for that additional visualization and animation work will vary depending on the complexity of the project, but is usually quite reasonable—especially given the quality of the final presentations that can be generated.

Collection and Post-Processing of 3D-Scanned Data

Before taking advantage of everything that 3D laser scanning can offer, the data must first be collected. The first step in that process is to retain a qualified 3D-scanning expert. Optimally, you will want to hire someone who has experience not only in performing the 3D scans, but also expertise in the various applications involved in converting 3D data into trial exhibits. Ask to see a portfolio of a 3D-scanning expert's work. A good scanning expert will provide suggestions about how the 3D-scanned data can be used to meet your goals—sometimes in ways that you would never have even imagined.

Once an expert has been hired, it's time to start planning for the scan. This may be a relatively straightforward process when only a small area or a single object needs to be scanned. However, for a larger scene, it may take time for a team of experts to plan and coordinate the scanning. For instance, how many scans will be required? How long will each take? Can it be done by one expert, or does it require a team? If scanning an accident scene, are there any site restrictions or safety concerns? What is the best type of scanner or scanners to use for the job?

Time can be a critical factor when conducting 3D scanning. Digital preservation is always most valuable when performed shortly after an event had occurred. Police markings and skid marks will fade. Trees, grass, and other plants will grow. Items at the scene could be moved, handled, or eliminated. A well-qualified 3D-scanning expert will be prepared to respond rapidly, and if at all possible, the expert should be called before any critical evidence is altered, even if a suit has not yet been filed.

Once the initial 3D-scanning process is completed, "post-processing" of the data must be performed to insure that it has been accurately captured and can be properly displayed. Post-processing converts the 3D-scanned data from its raw format into a format that can be viewed, analyzed, copied, and shared, as well as properly registering one scan or frame to the next. The registration process insures that all of the scanned data is aligned into one contiguous point cloud. Once all of the data has been processed and aligned, it is ready for use in any number of applications.

Admissibility of 3D-Scanned Evidence at Trial

We all learned in law school that there are two main types of evidence: substantive evidence and demonstrative evidence. Substantive evidence is used to prove or disprove a material fact in a case. Conversely, demonstrative evidence carries no independent probative value and its primary purpose is to illustrate the testimony of a witness. Whether this distinction is ever fully appreciated by jurors is highly debatable. Indeed, demonstrative evidence is likely to have a much greater effect on jury deliberations than many items of substantive evidence. Accordingly, when considering the admission of evidence based on 3D scanning, the ultimate question should not be how it is categorized for evidentiary purposes, but whether it will get before the jury in some form.

Historically, some courts have excluded the use of computer-generated animations on the basis that they did not accurately

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reflect the conditions at the accident scene. *See, e.g., Sommervold v. Grevlos,* 518 N.W.2d 733, 738 (S.D. 1994). However, because 3D scanning generates a nearly exact replication of an object or scene, it simply does not suffer from those deficiencies: it is, by definition, a "reflection" of what it sees. The evidentiary foundation for authentication of 3D evidence can thus be met by having a qualified person testify that the correct procedures were followed in performing the 3D scans and that the data derived from those scans has been properly preserved and processed. Essentially, a 3D scan is nothing more than a highly complex photograph, and courts should allow its admission into evidence as long as it is a fair and accurate representation of the object or scene.

When 3D-scanned data is being used to create more complex animations, it is important to determine whether there is any dispute about the accuracy of what is being depicted. If your opponent agrees that what has been represented is accurate, such as the movement of our light tower winch, then the animation can be offered into evidence as an ordinary exhibit. On the other hand, if your opponent disputes the accuracy of the animation, you can establish a foundation for its use by simply asking your witness if the animation will assist in explaining his or her testimony. Subject to the ordinary limits set by Federal Rule of Evidence 403, the witness should be allowed to refer to the animation in the same way that he or she would be allowed to draw a diagram or use a physical model to illustrate an aspect of his or her testimony. Once the animation has been utilized, you can then decide whether to seek its admission as an ordinary exhibit or for "demonstrative purposes" only.

The extent to which 3D-scanned evidence may be subject to challenge under Fed. R. Evid. 702 and *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993), will depend on whether the expert's opinions are actually based on that evidence. If the 3D-scanned data is only being used to illustrate the expert's opinion, then there should be no *Daubert* issue. Conversely, if your expert indicates that he or she relied on certain measurements obtained from the 3D-scanned data in reaching his or her conclusions, then you will need to be prepared to make a showing that this kind of data is reasonably relied on by experts in formulating their opinions. *See* Fed. R. Evid. 703. Given that there is a body of engineering organizations routinely using 3D scanning in a non-litigation context, there should be little difficulty in satisfying this burden. Indeed, at least two courts have found that 3D-scanned data can be used by experts in reaching their conclusions under *Daubert. Cordova v. City of Albuquerque*, No. 1:11-CV-0806 (U.S. Dist. N.M. Sept. 30, 2013) (unpublished ruling); *Haynes v. Lawrence Transportation Co.*, No. 1:13-CV-04292-LMM, 2016 WL 1359185, at *5–6 (N.D. Ga. Feb. 1, 2016).

Conclusion

For many years, judges and juries have primarily had to rely on static, two-dimensional photographs or diagrams in reaching their conclusions at trial. In today's *CSI*-based world, however, jurors expect to see compelling, cutting-edge technology that supports the arguments that the attorneys are making. 3D scanning is quickly becoming the new standard for accurately documenting and displaying evidence and can assist defense counsel in meeting those expectations. FD

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cal marijuana dispensaries since 2010, does not appear to have issued any formal guidance on the issue. The medical marijuana industry reached sales of 2.7 billion dollars in 2015. *See* Ian Lovett, *In California, Marijuana is Smelling More Like Big Business*, N.Y. Times, Apr. 11, 2016. However, notwithstanding California's lack of guidance, there appears to be a community of professionals supporting the medical marijuana industry. There are even continuing professional education courses tailored to California professionals, regarding the provision of accounting services to the medical marijuana industry.

The AICPA, in combination with the Colorado and Washington State Societies of Public Accountants, published an updated Issue Brief on state marijuana laws and the CPA profession in January 2016. This publication offers CPAs an overview of the legal status of marijuana and facts to consider when determining whether to provide services to the marijuana industry. *See* AICPA *et al., An Issue Brief on State Marijuana Laws and the CPA Profession* (rev. Jan. 8, 2016). The brief, along with a survey of the various states' advisory opinions published by the AICPA, was cited by the Arizona Board of Accountancy in reaching its decision.

With the growing number of state boards of accountancy ruling that the provision of marijuana-related services is permissible, subject to varying scopes, it would seem that the trend will continue as more states address the issue. This trend is particularly likely to continue where the state accountancy boards are reviewing and considering the guidance promulgated by other boards and the guidance from the AICPA.

While the board opinions from the various states alleviate some risk to CPAs rendering advice to marijuana businesses, the opinions do not provide any immunity from federal and state law enforcement initiatives. Whether the federal government continues to allow the marijuana industry to exist and supporting industries to provide services to it is a political issue that will come under heightened scrutiny as more states consider legalizing marijuana in the future. Until formal action is taken either to reverse or codify the guidance from the DOJ, the advisory opinions from the DOJ are a reliable source for professionals to consult to determine whether providing services to a marijuana business will present any problems. However, as long as the marijuana industry remains legal and expands in some states while remaining illegal elsewhere, questions regarding the provision of needed accounting services will continue to arise.

Navigating the changing landscape of the marijuana industry and state regulations regarding professionals offering advice to businesses requires careful consideration to avoid running afoul of the laws involved in this emerging and growing area. FD