NEW TECHNOLOGIES BOLSTER THE LITIGATION AND EXPERT PROCESSES

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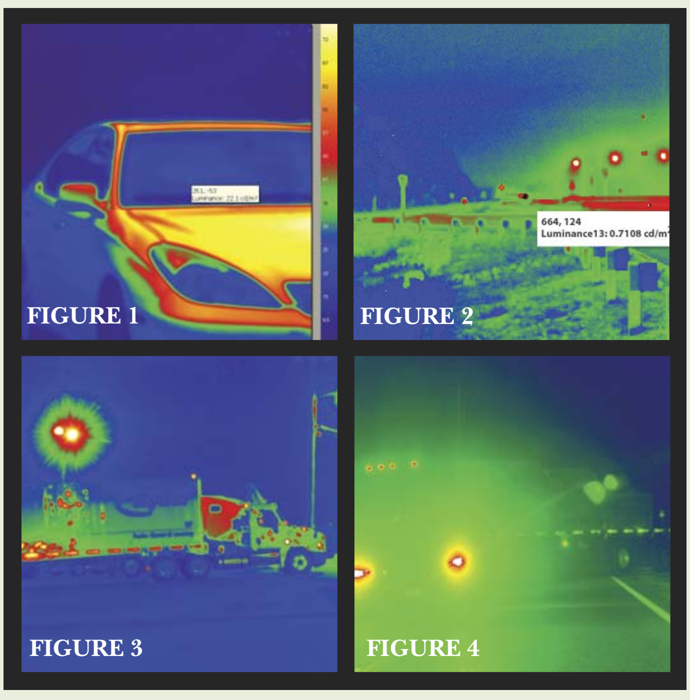
The use of new technology by forensic engineers and investigators during the scene inspection phase of a case allows for more compelling demonstratives throughout the litigation process. Two examples of new technology being used in the field are the 3-D laser scanner and the luminance imaging photometer. The 3-D laser scanner enables S-E-A technical staff to completely document complex environments by collecting millions of data points that can then be used to produce lucid demonstrative pieces throughout the litigation process. The luminance imaging photometer is unique in its ability to obtain an image that produces a luminance map with tangible luminance measurements of an entire scene. In effect, it allows the engineer to capture more measurements and provide more detailed/complex analysis than methods involving a traditional spot luminance meter. The data collected can also provide powerful demonstratives. Examples for both technologies and their potential application/benefit to cases in which USLAW attorneys/clients may be involved are provided in this article.



Despite the ever changing complexities and nuances of the legal industry, one thing has remained unchanged: you only get one opportunity to present your case. All the photos, documents and technical information are ineffectual unless they can be clearly conveyed to a judge or jury. For this reason, animations, simulations and models are increasingly used in the courtroom. If created and presented properly, complex ideas and situations can be demonstrated for all to easily understand.

Historically, the decision to incorporate demonstrative evidence does not usually occur until trial is imminent. At that time, the accident scene has almost certainly been altered and the ability to retrieve additional information has been reduced. Thinking proactively about the case, an attorney may want to have their consulting expert utilize advanced technology to document an entire scene digitally. Gathering this information at the time of the scene inspection provides more robust data gathering, which may prove to be more effective later in the lifecycle of the case. We offer two new technologies forensic engineers and investigators are using during the scene inspection phase of a case to provide for more compelling demonstratives throughout the litigation process: the luminance imaging photometer and the 3-D laser scanner.

When an accident occurs at night, or in diminished or adverse lighting conditions, many times the visibility of particular objects is called into question. What were the parties involved able to "see?" With the help of an advanced technology called the luminance imaging photometer, investigators with a unique skill set can answer this question quantitatively.

Visibility is a function of detection, information received by the eye, and perception. One of the first steps in evaluating visibility is typically to determine if an object in question can be detected. The most important parameter in establishing whether a pedestrian, an object, or a feature is visible at night is contrast. Contrast is the characteristic of "how readily an object will appear distinct from its background." In reconstruction of an accident, contrast can be measured accurately after the accident site and environment have been recreated to reflect the accident conditions.

Contrast is a measure of the difference between luminance values, where luminance is a measure of the light reflected to the eye by a surface. In a pedestrian accident, the amount of light reflected by the clothing of a pedestrian, as opposed to the light reflected by the background, is a measure of the contrast between the two areas. At night, in order to be detectable, the luminance of the clothing of the pedestrian must be perceivably greater or smaller than the background's, thus resulting in positive or negative contrast. Luminance can be measured with a calibrated spot luminance meter which allows single successive measurements at different locations. Calibrated luminance imaging photometers are also available that "image" the luminance of the entire scene, and thus capture thousands of luminance measurements at once.

The luminance imaging photometer is unique in its ability to obtain an image that produces a luminance map with embedded luminance measurements of an entire scene (Figure 1 and 2). In effect, it enables an engineer to capture more measurements and to provide more detailed or complex analyses than methods involving a traditional spot luminance meter. Furthermore, since the entire scene is captured, additional analyses not previously anticipated can be envisioned.

What do the additional analyses, technical jargon and big data mean for your case? It should result in the production of vivid visuals to illustrate the concept of contrast and its application to visibility in the specific setting at hand. For example, in the case of a tractor trailer moving across a roadway (backing into a driveway or pulling out of a perpendicular driveway), the question arises as to whether or not the trailer's side retro-reflective tape remains conspicuous to an approaching motorist. As pictured in Figures 3 and 4, the situation was captured for those two circumstances. Rather than opining in general terms about the effect of trailer angle or glare, S-E-A can perform an evaluation specific to the accident conditions. In both of these circumstances, S-E-A placed the vehicles in the proper reconstructed accident configuration and captured full scene luminance images which then enabled analysis of the contrast of the trailer, or specific portions of the trailer. The colors in the images are directly related to the level of luminance and, in simple terms, the larger the difference in color, the larger the contrast. Understanding that concept and looking at the images, it is evident even to the lay individual that the retro reflective tape and the wheels, for example, offer good contrast. And, the visual is technically supported by calculations using luminance data associated with the pixels in the image's area of interest. Such an analysis can also be used for pedestrian accidents to evaluate detection of specific colors of clothing or a safety vest, for example.

Such detailed analyses between adjacent regions is extremely difficult to achieve with a spot meter, and even more difficult to explain in the abstract. Today, foundationally correct luminance imaging can be obtained that captures more measurements, permits more complex analyses, illustrates the concept and levels of contrast, and shows which portions of a vehicle or a pedestrian are detectable for a given set of accident circumstances via colorful visuals.

Conceptually, a 3-D laser scanner can provide similar benefits to the luminance imaging photometer, but rather than luminance measurements, the laser scanner measures distances. Capturing measurements of a roadway, vehicle, or building by hand is a laborious and oftentimes dangerous task with large margins of error resulting in only a handful of scattered data points. The best surveying techniques produce data points in the hundreds, which, while more accurate than hand measurements, do not offer the full picture of the subject matter. Using 3-D laser scanning, however, produces millions of data points


FIGURE 5

FIGURE 6


FIGURE 7

accurate to within millimeters. Multiple scans can be "stitched" together, virtually replicating and preserving an entire scene or object in 3-D space. These "point clouds" of data are captured in a fraction of the time it would take to manually measure a few distances. Combined with post-processing by a skilled technician, the high-density point clouds can appear as solid 3-D objects, providing for simple, yet compelling demonstrative evidence. Furthermore, the point clouds can be used to generate full 3-D models for simulations and animations.

Rather than presenting a jury with static images of a scene, or a best-guess animation, imagine virtually and accurately "flying" the jury around, over and through the accident site or object. For example, two boats had collided and S-E-A was asked to determine the relative positions of the boats at the time of the collision. The only problem: the boats were being held in separate storage facilities miles apart. S-E-A scanned the boats and, using post-processing, manipulated the boats in 3-D space to properly align them in the position in which they collided, based on crush data also obtained from the 3-D scanner. Two pieces of a puzzle, each weighing thousands of pounds, were, with minimal effort, properly aligned in 3-D space and a clear demonstrative created. Images and animations can then be generated to clearly demonstrate an engineer's findings (Figures 5 and 6).

Often, cases involving vehicle dynamics or human kinematics require analysis using simulations in physics-based software. In these simulations, data accuracy is paramount as slight inaccuracies can produce greatly varied results. 3-D laser scan data can be utilized to generate 3-D models for the simulations (Figure 7). The accuracy of a surface generated in this way is such that engineers are able to determine factors such as steering inputs of a vehicle over a road, or the angle from which a person may have fallen on a sidewalk. The results of a simulation can then be exported into animation software, where, using 3-D scan data, accurate models of an entire scene can be generated and combined with the simulation in order to create demonstrative animations accurately depicting an incident. Furthermore, because the animation is based on scan data, the animation itself can be used for further analysis of factors such as line-of-sight.

While the purpose of this piece is to underscore the benefits of using technology early in a case to produce clear and convincing demonstratives, there are many other advantages that the scanner and photometer provide which have not been discussed here. These include: preserving data for future and unforeseen analyses, easily capturing measurements in dangerous or time-sensitive scenarios, and measuring highly varied objects such as trees, telephone lines, and vehicle crush.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