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Computer-Generated Visualizations: From the Scene to the Courtroom

The total station *is used to collect extremely accurate scene and vehicle crush data. This data forms the basis for all of the analysis that follows. It is utilized in the technical analysis of the crash event as well as for the visualizations. The use of automated data collection provides a seamless, fast and cost-effective transition directly into the simulation program and, ultimately, the visualization.*

The total station is an electronic mapping tool that records the location of each data point in three dimensions (3-D). It works by sending out a beam of near-infrared light to a reflective target, usually a prism, positioned over the spot to be measured. The time it takes for the light beam to reach the prism and reflect back is electronically measured by the total station and converted into a distance measurement. With this information the true three-dimensional coordinates of the target point can be found.

The collected data is then downloaded into a CAD (Computer Aided Drafting) program for further analysis.

A computer-generated visualization used as a courtroom exhibit can be a powerful medium for getting information to the jury, but is it scientific and reliable? Will it even be admitted in court?

To answer these questions, it is important to understand the differences between an animation and a scientific visualization. Animations do not necessarily comport to the laws of physics or geometry. In fact, cartoons deliberately distort reality to create humor.

In scientific visualizations, on the other hand, the laws of physics and the laws of visual perspective are obeyed. Simulated motion is based on the laws of physics and is derived from a recreation in the computer environment. The results can be displayed in real time, showing how the accident occurred, or slowed down to show details of motion. In some instances, it may also be necessary to obey certain laws with respect to conspicuity as well, such as nighttime visibility and obscuration.

The 3-D graphic visualizations created by Ruhl Forensic utilize validated simulation software subjected to peer review that attests to the accuracy and reliability of the solution methodology.

The process of creating a scientific visualization begins with the initial data collection. This data is the basis for any analysis that follows. Ruhl Forensic staff uses a total station, an electronic mapping tool that records the location of each data point in three dimensions (3-D) to a very high degree of precision and accuracy, to map the crash site geometry and physical evidence, thereby accurately documenting the crash site and preserving physical evidence.

The total station is capable of documenting all tire marks, gouges, fluid spills and tire tracks. It can be used to determine the slope of the roadway and medians, the width of the shoulder and the cross slope of the roadway, location of traffic control and road signs, and any obstacles to visibility. It can even be used to accurately measure objects above ground such as signs and buildings. All of this information will be used to create a faithful representation of the scene in a 3-D, real world environment.

This visualization of a highway construction work zone shows that the driver of the vehicle obeyed the temporary traffic control devices that sent him directly into the unmarked barrier protruding into his lane, resulting in two fatalities. The airman was later exonerated of all charges related to the crash.

The same technology is utilized to document the crush damage to the involved vehicles. The crush profile of a vehicle can provide useful information in reconstructing how the vehicle's speed changed during an impact. This is referred to as the Delta-V of the collision. The total station is highly effective in doing a very accurate crush profile of the vehicles, preserving the data for later use.

One useful feature of the latest generation of total stations is the ability to collect data in areas and from objects that were previously inaccessible, such as electrical wires, overpasses and bridges. Also remote operation is pos-

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Ruhl Forensic, Inc.'s staff *provide expertise in: mechanical and electrical engineering, collision investigation and vehicle dynamics, biomechanics and human factors, heavy vehicle driving and mechanical systems, federal regulations and compliance, fleet safety, traffic engineering, construction zone safety, OSHA, graphic visualization, and other areas.*

Our experts provide a continuum of service from initial on-site investigations through research, testing and reconstruction to courtroom testimony and presentation graphics and visualization.

We offer quick response to your investigation needs 24 hours a day. Contact us by calling 1-800-355-7800, 1-800-235-2808, or 1-800-278-4095.

Please feel free to call us with any questions that you may have and we will direct you to the appropriate individual within our firm.

sible, allowing the technician to gather data from a busy highway without ever stepping into the traffic lane.

By capturing the measurements in a 3-D format, Ruhl Forensic's staff have the data necessary to perform a comprehensive analysis and to create graphics and exhibits ranging from 2-D drawings to 3-D graphic visualizations of crash events.

While at the scene, photographs and video are taken to further document the scene and the vehicles involved. Signs and other artifacts unique to that location will be utilized in the final visualization.

The data collected by the total station is downloaded into a CAD (computer-aided drafting) program that accurately recreates the scene in a 3-D environment. Vehicles, created in a CAD program or imported from an existing database, are then placed in the 3-D scene environment for analysis.

The resulting simulation of the accident scenario portrays a highly accurate, scientific representation of the vehicle interaction within the 3-D environment.

To make the scene as realistic as possible, the final step in the creation of the visualization is to combine the simulation results with the photos and video taken at the scene to create a realistic and accurate reproduction of the accident event and the visual environment. Although a simulation may show the movement of objects correctly, the addition of these images, which may include signs, foliage or other artifacts at the scene, often greatly aid the viewers in quickly becoming oriented to a scene they may never have visited.

Visualizations can also be used to show alternative scenarios. In this instance, the visualization demonstrates that a properly loaded tractor-trailer could negotiate the turn at speeds significantly higher than those posted proving that the shifting load, not speed, was the causal factor in the accident.

The completed visualization is a powerful courtroom exhibit. Prepared by using simulation software, incorporating the precise and extensive measurements allowed by the use of a total station, and combined with a sophisticated analysis by Ruhl Forensic staff, the visualization will aid the jury in understanding the collision event. Because of the accurate evidence documentation and readily available simulation input data, the testing is repeatable by other parties. This creates a strong case against admissibility challenges.

For further information on this topic, please contact us at ruhl@ruhl.com or by calling the Champaign, IL office at (800) 355-7800, the Scottsdale, AZ office at (800) 235-2808 or the Chicago, IL office at (800) 278-4095.