Fatality Scene Diagramming and
3D Vehicle Modeling with iWitnessPRO™

Background:

iWitnessPRO was employed to carry out an image-based mapping of a fatal car crash, which occurred when a driver lost control of his vehicle on an off-ramp from Interstate I-25 in Colorado. As well as being used for the mapping of the multi-car accident scene for diagramming purposes, iWitnessPRO was also employed to both measure the crush profile of one of the extensively damaged vehicles, and to generate an accurate digital 3D model of the same vehicle.

Crash scene diagramming:

The diagramming of the crash scene, showing the final rest positions of the vehicles involved in the crash, is illustrated in Figure 1, whereas the extensively damaged vehicle to be crush-profiled and modelled in 3D is shown in Figure 2. A Nikon DSLR camera was utilized to record the photography of the scene, with the subsequent iWitnessPRO processing being conducted as three overlapping networks which were joined to form the measurement result shown in Figure 1. Shown in Figure 2 are two of the photogrammetry markers which serve as convenient, recognizable features that identify details of interest in the photogrammetric measurement process.
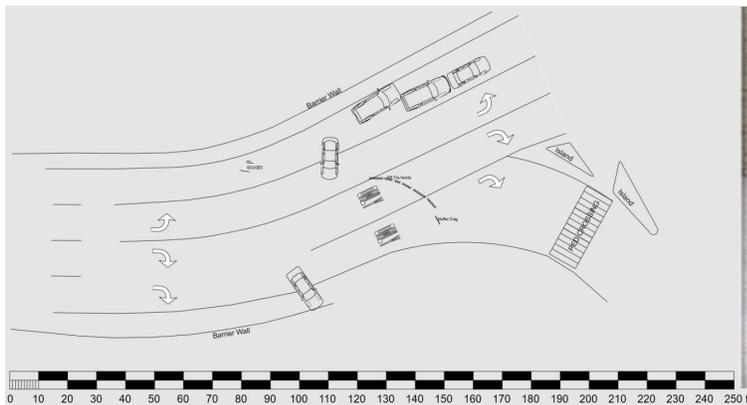

Figure 1: Crash scene diagram   Figure 2: Vehicle to be crush profiled

One of the merits of accident reconstruction via photogrammetry is that the short time required to capture the images means that the road can be reopened earlier than is otherwise the case. In this instance, the on-site time to record the photography was only 25 minutes. In regard to accuracy, the same-day mapping of photogrammetry markers and feature points of interest was conducted to 1-inch (2.5cm) accuracy.

Crush Profiling

Following clearance of the crash site, a crush profiling of one of the vehicles that is shown in Figures 2 and 3 was conducted. Some 60 reusable iWitnessPRO coded targets were temporarily placed around the vehicle to assist in fully automatic camera orientation within iWitnessPRO. 50 images were then acquired of the vehicle in an all-around configuration. Following network relative orientation, feature points of interest on the vehicle were digitized in 3D so as to quantify the degree of crush, which involves a comparison of the nominal shape of the vehicle to is post-crash shape.

Figure 3 illustrates the triangulated 3D object points of the crush profile in one of the recorded images, and Figure 4 shows a plan view of the crush profile as exported from iWitnessPRO to CAD for analysis of velocity-on-impact and other factors.

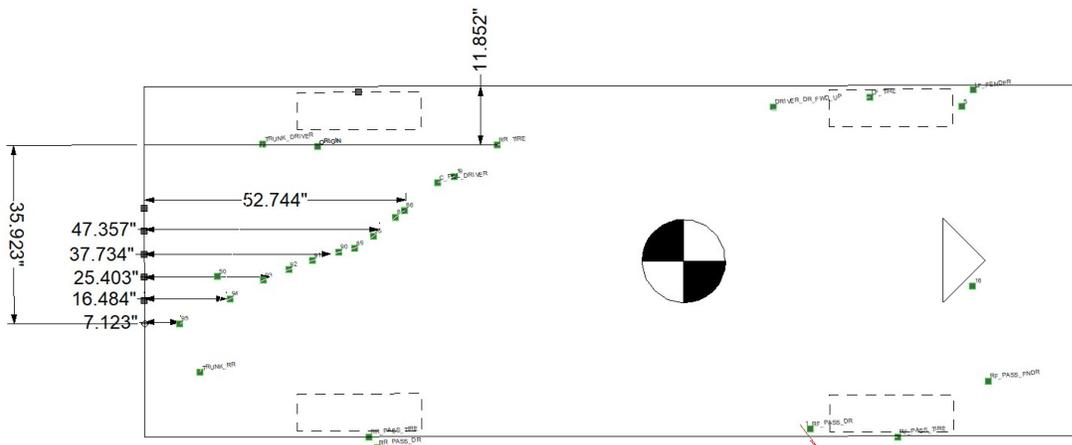Figure 3: Image showing coded targets and feature points in the crush profiling

Figure 4: Crush profile illustrating extent of deformation of the car body

Post-crash 3D vehicle model

Subsequent to both the diagramming and crush profiling related to the accident, a photogrammetric survey was conducted to generate a 3D photo-realistic model of the vehicle shown in Figures 2 and 3. iWitnessPRO was again employed to generate the dense point cloud depicted in Figure 5. This 3D model then supports direct digitization, within software systems such as FARO Zone's FZ3, of any visible point of interest on the vehicle. Although coded targets can be seen in Figure 5, these are not required within the dense 3D point cloud generation process, which in this case took about 30 minutes.

Figure 5: 3D model of crushed vehicle in the form of a dense point cloud.

Summary

iWitnessPRO is a low-cost, image-based mapping tool that has demonstrated on numerous occasions its capability for fast, economical, accurate and highly automated 3D mapping and feature measurement in forensic applications. All these attributes were called upon in the cases of accident scene diagramming, crush profiling and 3D modeling summarized here, all of which utilized images from a hand-held, off-the-shelf DSLR camera. On-site time for photography was less than half an hour in each instance. The photographic record allows follow-up mapping at any time, and indeed the photo-realistic 3D model of Figure 5 affords 3D visualization and further CAD measurement analysis should it be required.