

Crash Scene Mapping Solutions for Quick Clearance during Inclement Weather

By Lee DeChant



One of nine digital images acquired by the Minnesota State Patrol and mapped using photogrammetry

Inclement weather conditions often make it difficult for the police officer when measuring evidence at a fatality crash scene. It is common for numerous crash events to occur over a short period of time when bad weather contributes to vehicular crashes. The police officer's time on scene to gather critical evidence for diagramming a crash can be time consuming when traditional mapping tools are employed. The required mapping task is exacerbated by the demand that the officer move on to the next emergency service call as quickly as possible.

Sergeant Don Schmalzbauer, Supervisor and Training Coordinator of the Minnesota State Patrol's (MnSP) Major Accident Investigation Team (MAIT) began looking into alternative mapping solutions in 2000 to improve and reduce clearance time after traffic incidents occur on Minnesota highways. One method Sgt. Schmalzbauer realized for quick-clearance while maintaining accurate scene diagramming is the use of a technology called *close-range photogrammetry*. Photogrammetry is the process of recording 2D information on multiple analog pictures or digital camera images. The "camera acquired" 2D information is bundled through special software calculations that solve for the

camera's orientation and performs a triangulation process to compute 3D coordinates from 2D images. Today's powerful photogrammetry software systems semi automatically or fully automatically solve for 3D data extracted from pictures. After years of following improvements in close-range photogrammetry software, in 2004, Sergeant Schmalzbauer began investigation and free trial use of a photogrammetry system designed specifically for accident reconstruction called iWitness™. Due to his positive trial results achieved in 2004, the Minnesota State Patrol adopted iWitness statewide in their MAIT operations in fall of 2005, with software training provided by the vendor.

Elsewhere in the US, photogrammetry is quickly gaining the attention of state and local law enforcement agencies as it offers a low-cost, fast and accurate means of digitally recording the crash scene evidence. For example, the Florida Highway Patrol and the New Hampshire State Police are using the technology in their statewide crash scene mapping tasks. Pictures recorded at the incident create a permanent and irrefutable record of the crash evidence, which can later be measured any time after the crash scene – long after the road is reopened.

This article focuses on one particular crash scene, documented by the MnSP using close-range photogrammetry during a snowstorm in mid December 2005. The MnSP Trooper responsible for the service call, and scene diagramming was Trooper Jeffrey Westrum – MAIT. Trooper Westrum's has over 9 years of experience with the MnSP MAIT, using traditional mapping tools (including total stations) for fatality crash scene mapping. In October of 2005, Trooper Westrum and the other MnSP MAIT troopers from across the state were trained in the use of the iWitness close-range photogrammetry system www.iwitnessphoto.com for crash scene and forensic mapping.

The Crash Fatality

Trooper Westrum explains “the crash took place during a snowstorm, where the crash happened during the late morning hours. The road was icy and there were many calls for service already that morning due to the icy conditions. Snow was falling at a good rate, coupled with strong gusting winds causing the immediate area of this particular crash scene incident to rapidly fill with snow. The position of the crash occurred at the end of a sweeping curve on a 2-lane highway in south-central Minnesota. A tractor/trailer (semi truck) was traveling westbound, while a mini-van was driving in the eastbound direction. The tractor/trailer had lost control as it rounded the roads curve, becoming “jack-knifed”.

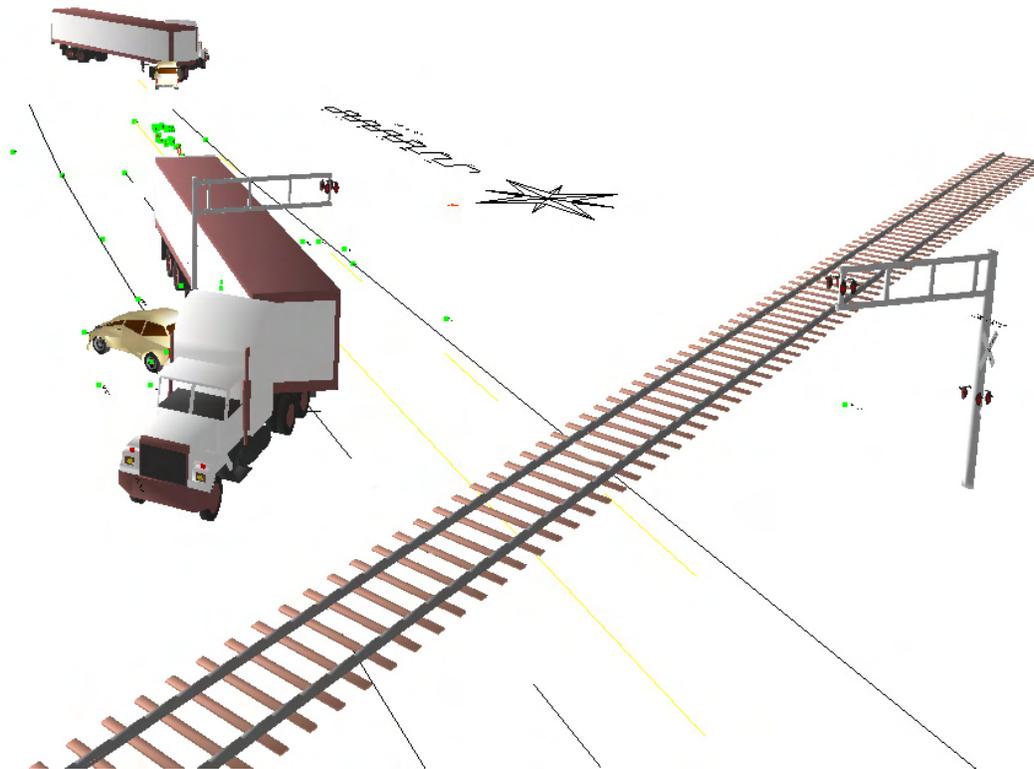
A snapshot of Photogrammetry

Close-Range Photogrammetry is non-contact measurement that requires multiple pictures captured at the scene for measuring feature points of interest. The technology is best applied by using a good quality digital camera for fast, accurate and permanent 3D data recording.

Some Photogrammetry Applications in Accident Reconstruction are:

- Crash scene mapping
- Vehicle crush profiling
- Homicide scene mapping
- Aerial 3D diagramming
- Bullet trajectory
- Mapping road and surface defects
- Using others (bystanders) pictures for extracting critical measurements
- Used cooperatively with other measurement technologies for scene diagramming

The tractor/trailer was jackknifed across both lanes of traffic where the mini-van struck the aft portion of the tractor's rear wheels. The force of the impact and momentum of the collision projected the mini-van in its opposite direction of initial travel, thereby striking a railroad signal post at its final rest position. The tractor/trailer combination continued in the same direction of momentum as the mini-van, striking the mini-van against the railroad signal pole. Two people were killed in the crash.”

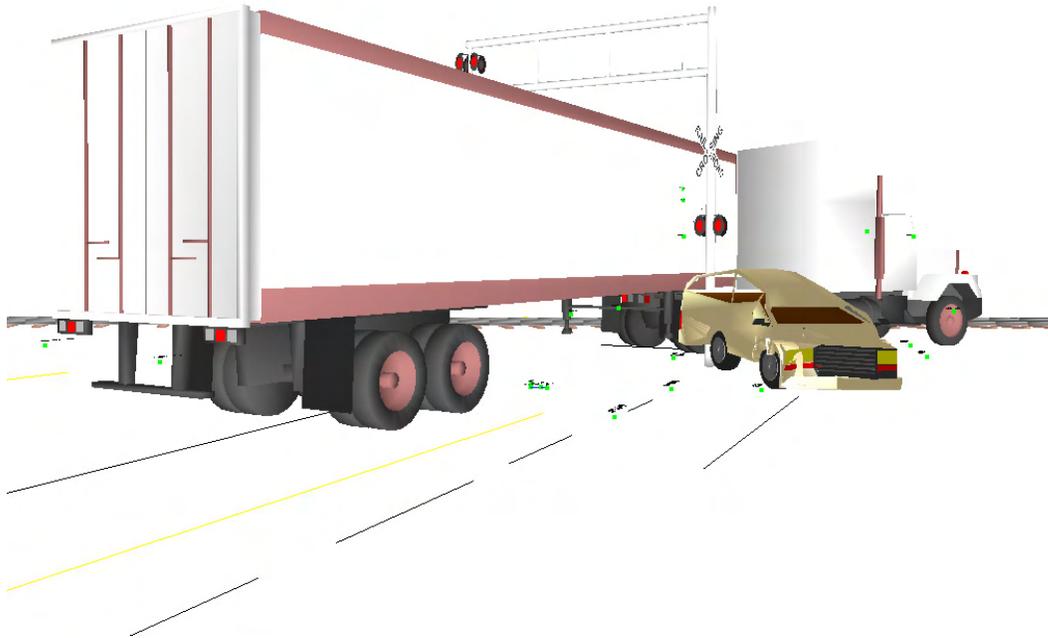


Point-of-impact in distance (top left-center). Final rest at railroad signal post.

The On Scene Mapping

Trooper Westrum continued to explain “I had the option of driving back to the MAIT office and getting the total station to map the scene. All other state trooper’s that morning were assisting in different crashes. The fact that it would have taken at least an hour for me to acquire, and then setup the total station, as well as require the support of another state trooper to help map it, made me decide that utilizing the iWitness photogrammetry method was the best choice. On scene, it only took me a few minutes to setup four photogrammetry-scaling distances and approximately 10 minutes to take the required digital pictures of the crash scene for later measurement using the photogrammetry method.”

“I used a total of six special photogrammetric evidence markers for my known scaling distances to setup and accomplish the photogrammetry pictures for the measurement process. Using iWitness for this crash allowed me to document and then clear the scene within 45 to 60 minutes. The relatively small amount of time that I needed to be present at the crash scene allowed me to clear it, and move on to the next call in a remarkably fast amount of time Vs traditional methods. Noteworthy is the fact that it was only *my time* at the crash scene, and that I didn’t need to have a second trooper present to assist, thereby doubling the number of personnel hours needed to document this critical event.”



Final rest of vehicles illustrated in the Crash Zone from the iWitness photogrammetry 3D modeled data

“As stated previously, the snow was an extreme factor in dealing with this crash. The snow had masked critical evidence. I was able to go back to the crash scene a few days later and locate critical evidence that indicated where the point-of-impact of the vehicles occurred. Using my digital camera for iWitness once again, I was able to spend less than 20 minutes on scene and photograph the additional crash evidence – (amounting to a total quantity of 121, 3D data points). Using the power of photogrammetry, I was able to tie-in the photographs taken the day of the crash, with the photographs that I took days later to create a complete 3D photogrammetric model of the evidence for diagramming the crash event.”

“Using photogrammetry allowed me to document more evidence in a much more detailed manner than what could have been accomplished using a total station. The time it took to

measure the critical evidence on the computer and create a scaled diagram was under two hours – back in the warmth of the office in December 2005. The greatest advantage I see in this particular crash was, the detail work was done in an office by one person, not in the middle of swiftly moving traffic during inclement weather by two people. Given the cold weather conditions and volume of traffic, I could not have documented as many separate road surface gouges and other evidence that I detailed using the photogrammetry method verses that of a total station or baseline approach.”

“Using the pictures (and photogrammetry) I can articulate key points that were measured on the scene by showing someone a photograph of the scene. Using the iWitness photogrammetry system allows law enforcement to not only show the evidence in the photograph, but the precise 3D measured point location - right on the pictures.”

“Once the 3D points of evidence are easily documented and measured within the photogrammetry program, it takes only a press of a button to export the data into a drawing exchange format (DXF) for import into one of our drawing programs. The process of the photogrammetry to CAD is quick and easy. ”

Trooper Westrum adds: “Sergeant Schmalzbauer and I also teach other Crash Reconstructionists how to use the total station and related diagramming software programs. It is our opinion that there is not one single perfect solution for mapping scene evidence that fits all of our MnSP needs. Having the iWitness photogrammetry system as one of the tools in our ‘toolbox’, allows us to document evidence immediately on scene, versus the time of setting up a total station and measuring one point at a time. Or conversely, having to mark the scene and then wait until we can even get a total station to the scene, which typically requires two troopers for the mapping task. Having used iWitness for several crashes in only a few months after our initial MAIT training, has proven to me the accuracy and relative ease of the photogrammetry software as a value-added addition to our MnSP MAIT mapping tools.”

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