Photo Rectification Plays an Important Role for Determining Fault in a Two Vehicle Crash

By Lee DeChant
DeChant Consulting Services – DCS Inc

Background

Photos of a crash scene can play an important role in measuring evidence through photogrammetric modeling and image-based rectification. In this instance, a single photo was taken by a police officer and used to reconstruct the position of vehicles involved in a head-on crash. The police photo was rectified, where the camera aim point (i.e., an oblique view) was transformed into a normal view (i.e., a plan view.) From the plan view, the photo can be accurately measured to help clarify what happened in the crash; either supporting, or conversely conflicting with what two drivers reported to police after the wreck.

The Crash

An SUV (Vehicle 1) was traveling Northbound on a two lane road. The driver of Vehicle 1 made an evasive action swerving to avoid hitting an animal crossing from the eastside of the roadway. At the same time, a driver of a truck (Vehicle 2) heading southbound had locked-up the brakes - also swerving across the centerline. Vehicle 1 and Vehicle 2 collided on the northbound lane side, which was evident by the road evidence and point-of-impact.

The driver of Vehicle 2 stated to the police that the driver of Vehicle 1 was "*completely in the southbound lane*". The police report was subsequently filed with the incident being the responsibility of the driver of Vehicle 1.

An experienced reconstruction practitioner reviewed one of the scanned police acquired scene photographs – analyzed months after the incident. The reconstruction practitioner determined that the police photograph revealed faint tire markings of the Vehicle 1 driver's side tire (a yaw-mark) crossing-over into the southbound lane. Visually, from the photograph, the tire mark of Vehicle 1 appeared to be less than one-foot into the opposing lane in relationship to the solid double yellow centerlines. If that were the case, the driver of Vehicle 2 could have just stayed "on course" (southbound), or swerved just slightly to their right, in the southbound lane and the two vehicles would not have contacted each other.

Proving Vehicle Position through Photo-Based Rectification

The reconstructionist had contacted DeChant Consulting Services (DCS) for support in measuring the tire marking of Vehicle 1. DCS reviewed the scanned image and felt there was enough natural feature entities present for control point marking (a minimum of 4 points) for planar rectification, which would yield the required tire measurement of Vehicle 1.

The scanned photograph displaying the faint tire marking of Vehicle 1 and Point Of Impact, was actually 'marked-up' by someone with a ball-point pen

before it was scanned and the image quality of the scan was certainly not "high resolution"; but nevertheless, at the time of preliminary photogrammetric review, the scanned photo was still believed to be satisfactory for the image-rectification and measurement process.

The reconstructionist went back to the scene and imaged it with a *metrically calibrated* consumer grade digital camera. Specific natural features were key (i.e., present in the field-of-view during the scene photography/survey.) These digital images would then be measured later with the ***iWitness*™ photogrammetry software system** (www.iwitnessphoto.com) by deriving "*control points*" for the image rectification using the **XYRectify™** (XYR) software program. The same *control points* were marked in the scanned police photo (Figure 3) for the rectification process.

It should be noted that XYRectify assures the scanned pixels (i.e., rows & columns of pixels) are square – a requirement for accurate rectification measurement. As previously mentioned, the oblique view of the photo is transformed into a "normal" or in this case, a "plan view" (Figure 4). With the image rectified, it can then be measured accurately in the XY axis (i.e., in the plan view.) In this accident, the position of the Vehicle 1 tire mark as it relates closest to the double yellow centerlines (see yellow arrow in Figure 1) was measured to be less than 4". The physical orientation of the two vehicles upon crashing (i.e., point of contact) was determined through review of multiple crash scene photos taken by the police.

Figure 1 is the oblique police photo with Vehicle 1 "cross over" tire mark

Figure 1

Figure 2 are "control points" measured months after the crash in *iWitness*

Figure 2

Figure 3 are the same "control points" marked in *XYRectify* (for rectification)

Figure 3

Figure 4 The scaled and rectified photo with CAD overlay (plan view)

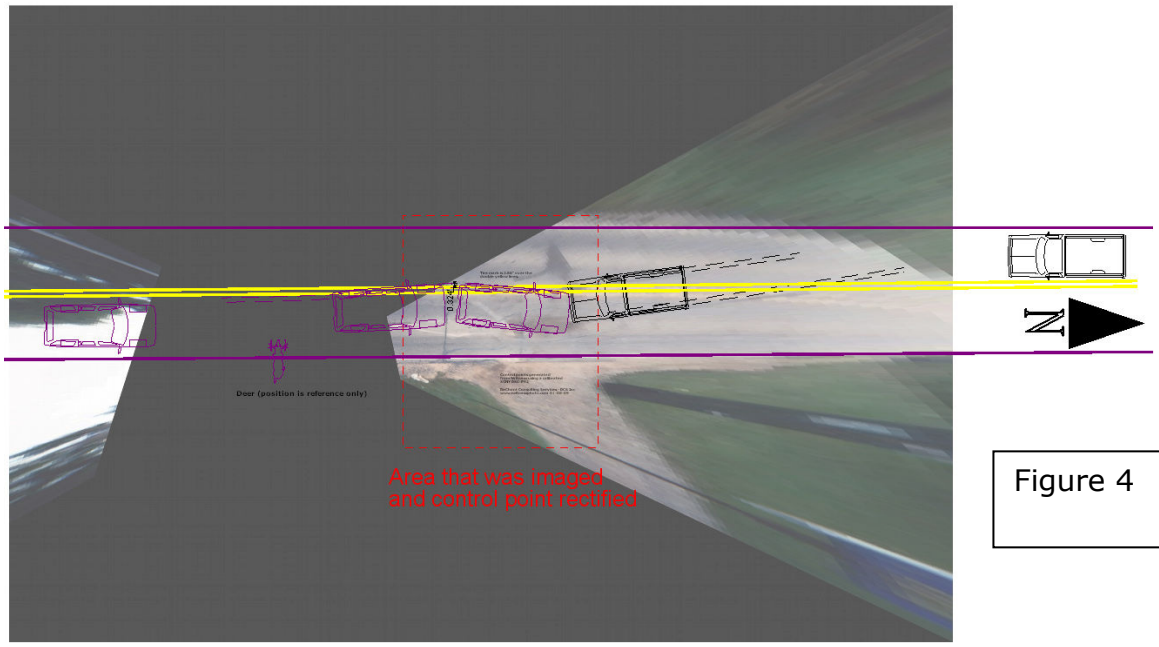

Figure 4

Figure 5 oblique view looking north (SUV in Purple). The deer location is reference only

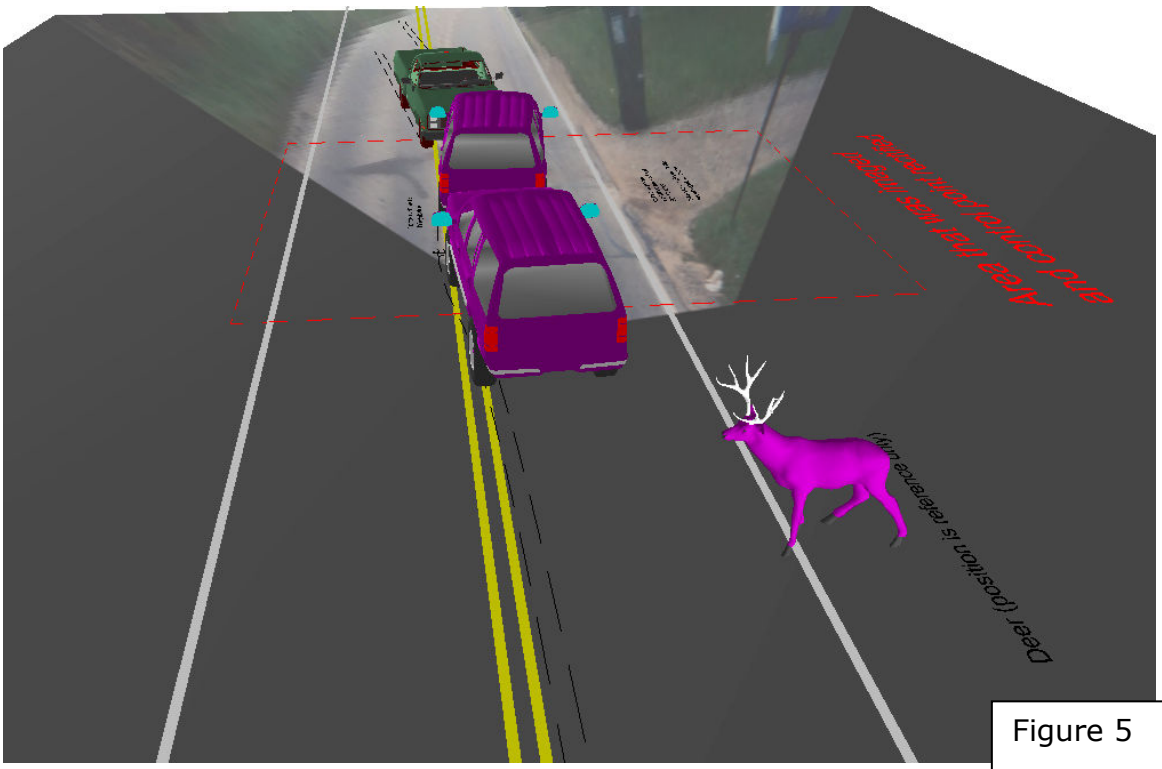

Figure 5

Summary
Image-based rectification requires the area rectified to be fairly flat for 2D measurement within the rectified plane. From this plane, four (or more) spatially separated 2D (XY) or 3D (XYZ) coordinates (referred to as Control Points) are required to convert the oblique photo into a plan view for accurate measurement. The rectified image (once placed in a CAD diagramming program) also requires unit scaling in either the X or Y format of the image.

iWitness and XYRectify are low-cost, accurate and easy to use image-based measuring tools for accident reconstruction and forensic measurement. The method for mapping from a single scanned photo, recorded from a police officer, has been summarized here. In many applications XYRectify (single-image rectification) can be used in the event the scene evidence was overlooked by the investigators (i.e., lack of being tape measured, or laser measured with a total station.)

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