Laser Scanning Technologies Within Crime Scene Examination

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The purpose of this document is to serve as a guide for the inclusion of laser scanning technologies within the field of crime scene investigation. Although the Leica ScanStation C-10 is the scanner currently in use by the writer, neither the writer nor his employer make any representation the Leica C-10 is the best or only available technology to employ. The writer further makes no suggestion that one laser-scanning device or distributor is higher or lower regarded within the field. There are a number of reputable vendors for scanning technologies and a comprehensive evaluation and comparison should be conducted before committing to the purchase of one of these devices to fit the needs of your professional entity.

The purpose of a systematic crime scene examination is to discover probative items, document the scene and collect the items in as pristine a condition as possible. Crime scene examiners strive to complete the tedious process of documenting the discovery of items through the collection phase to protect the integrity of the evidence in question. Examiners accustomed to utilizing traditional photography and measurement techniques have recently been offered assistance from the engineering and surveying field by way of laser measuring devices intended to capture millions of points of data measurements within a relatively short period of time.

Innovative solutions utilizing technology are prevalent throughout law enforcement. Crime scene examination should not be immune to technological advances when they improve the quality of the work. The proliferation of digital photography within the field, which has all but replaced 35mm film, is one example of the adaptation of technology for the efficient progress of crime scene examination. Laser scanning is yet another example of

an innovative solution that is making its way toward general acceptance as a crime scene documentation method.

Implementing a scanner operation within a crime scene has a few variables that should be considered. Within an interior or confined scene the scanner and its operators may be additions to, and therefore sources of unintentional contamination or disturbances to a crime scene. Consideration should be given to route of travel within the scene as well as equipment placement to minimize the potential for negative impact to the scene.

The use of a scanner may also serve to mitigate the potential for unintentional contamination or disturbance of a crime scene. Because of its very nature of being able to accurately measure from a distance, the scanner may be able to be utilized from outside the inner perimeter of the crime scene to completely avoid contamination or disturbance considerations. This is especially true for open floor plans in an interior scene and many exterior scenes.

Final decisions for use and equipment location placement should rely on a collaboration of ideas among the investigators in charge of the actual crime scene investigation and the scan team members assisting them. It is important to remember that a scanner project is usually a technological supplement to the crime scene examination. Traditional documentation methods should not to be replaced or neglected because of the use of a scanner. Fundamental crime scene documentation methods may, in fact, be the foundation upon which the scanner-produced products are supported for presentation to the appropriate fact finding entity.

Laser scanners operate on a line of site basis. The Leica ScanStation C-10 has an effective range of a couple hundred feet in two directions. Manufacturer product

specifications list a maximum range of 300m or 900 feet. This long range is of direct benefit for vertical measurements. However, we have learned that targeting for registration is often easier by segmenting the scene in shorter horizontal distances because of outside influences such as terrain, wind, weather, vegetation and lighting. These outside influences can hinder the ability of the scanner operator to efficiently acquire targets. Many times it is simply easier just to add an additional scan world location for a large area. Adding scan world locations can also assist in creating the fullness of the 3-D model produced by the project by eliminating some of the shadowing of areas blocked from line of site from a single direction or perspective.

Interior scenes present a unique set of operational hurdles. The scanner can rotate horizontally 360° and vertically 270° to capture data. It cannot see below the tripod area so that creates a void in the data at a single scan world location. Working indoors can be difficult because of limited space in the area that would be optimal for scanner placement. Cramped quarters often create the need for additional scan worlds for the purposes of mitigating the potential for contamination of evidentiary significant areas, maintaining clear lines of site around architectural features or furniture and to fill in data points missed by the shadowing of areas lacking line of site from other perspectives.

Utilizing targets in an interior scene can also be restrictive because of the layout of the structure. Our protocol is to include a NIST certified twin target pole within each scan world when possible to add to the integrity of the workflow. Twin targets are somewhat cumbersome and are another equipment addition within a crime scene. In addition to using targets placed within the scene for point cloud registration, the software used for postproduction has the ability to register the point clouds using a cloud-to-cloud method

that is done by the operator defining common points within the renderings and connecting the point clouds in a manual registration process. In small confines this methodology works well to minimize the equipment required within small areas inside an inner perimeter.

Exterior scenes often present different problems that must be addressed. Among those can be moving pedestrian or vehicular traffic within the scene. Some postproduction work can eliminate unwanted transient aberrations within the scan data. When practical, temporarily stopping or diverting traffic is a consideration to produce cleaner scans. Conversely, the ability to scan areas such as busy roadways without having to stop or divert traffic is unique to this technology. A very high quality model of a roadway can be produced without the need for additional personnel for traffic control. A scanner team has the ability to render a complete 3-D model of a complicated highway interchange with minimal to no impact on traffic.

Like any traditional documentation method, inclement weather can also be a consideration for exterior scenes. Thick fog, heavy rain, snow and even strong wind can create conditions that may preclude the use of a laser scanner depending on the specific circumstances. These same environmental considerations are present for a number of other crime scene resources as well including traditional photography equipment or other electronic equipment.

Some scenes in which laser scanner technology can excel over traditional methods are those that require measurement data from extremely irregularly shaped subjects. These could include post-blast dispersion, crater shape including depth or damage to vertical surfaces that are impractical to easily measure by conventional means. Fire scenes

are also scenes in which laser scanning could prove to be irreplaceable. Whether the area is unreachable or unsafe to manually measure, a scanner may be able to be used from an area not subject to safety hazards to document fire damage. Large debris fields consistent with aircraft crashes or multi-vehicle catastrophes are also scenes that laser-scanning technologies may be implemented for the collection of large amounts of measurement data in a relatively short period of time compared to conventional methods. Although measuring into water is not possible because of reflection and refraction of the laser light, utilizing a scanner to measure and document the area around the body of water such as a lake front or pond is easily completed with the scanner limited only by the line of site obstacles at the scene.

With the ability within the software used for postproduction to model objects into the point cloud visual rendering, trajectory analysis is another area in which laser scanning is very beneficial. Traditional bullet trajectory analysis relies on the placement of trajectory rods within the path of the bullet as identified by the crime scene investigator. Utilizing scanning technology, trajectory rods can be scanned and subsequently modeled and extended within the postproduction software to recreate the probable path toward the origination point. Distances, angles and viewpoints from the originating and terminating ends are all possible benefits from combining traditional and laser scanning methods for trajectory scenes.

Low light is a factor that affects all scenes. Low light diminishes the aesthetics of both the exhibits exported from Cyclone as well as the distributable end product viewed within Internet Explorer with a free viewer plugin named TruView. Scanning in one direction and lighting the subject area from behind the scanner can supplement lighting in

low light situations to improve the quality of the imaging process. The supplemental lighting can then be moved to the opposite side of the scanner if the area behind the scanner is needed within the project. Low light only affects the quality of the panoramic photography produced during the imaging process. Low light, and even no light, has no effect on the actual scan measurement data. Even in complete darkness laser scanning will produce a hue intensity map of point cloud data that can be used for rendering usable measurement results.

It is important for the investigators in charge of the crime scene or investigation to consult with the scanner team members to insure that appropriate scans are made to meet investigator's expectations. Results can be provided by several methods. Cyclone is the software used by this writer to perform the postproduction processing of the raw scan data into a presentable end product. Scan team members can provide live data review directly from the Cyclone software when needed. Snapshots from within Cyclone are easily included within PowerPoint presentations to utilize still views of Cyclone perspectives without the actual need to have a computer loaded with Cyclone.

Cyclone also has the ability to export an immersive panoramic image set viewable within Internet Explorer on any computer with a free TruView plugin installed. The TruView export from Cyclone allows the end user to move around within the scene at the perspectives from which the scanner was operated. TruView also provides tools to create hot links to include additional photography within the presentation. Tools are also available to do some basic measurement tasks within the TruView interface as well as label items of interest.

Scanning technologies, although relatively new to crime scene application, are founded in sound engineering methodology. Consideration for implementation at a scene is the responsibility of the investigators in charge of the scene. Those investigators should consult with scan team members to determine if there is value added by use of the technology. The value of the scan data may be immediate because of the vast amount of data it can collect or the value may be intrinsic because of the ability to historically archive the scene for future review. When appropriate, scanning technologies are an innovative solution that should be utilized by crime scene examiners along with traditional methods to completely document their scenes.

References

"Leica ScanStation C10 Product Specifications." Leica Geosystems AG Heerbrugg, Switzerland. 19 May2013. http://hds.leica-geosystems.com/downloads123/hds/hds/ScanStation%20C10/brochures-datasheet/Leica_ScanStation_C10_DS_en.pdf