C22 Determining Range of Certainty in Photogrammetry and Videogrammetry

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Learning Overview: After attending this presentation, attendees will have been presented with a straightforward methodology for determining range of certainty in both single image photogrammetry solutions as well as multiple image photogrammetry solutions. This methodology has the added benefit of relating the range in specific measured units and resulting imagery to visually demonstrate the range. Research comparing known errors and determined ranges of certainty will be presented to validate the methodology.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a meaningful way of determining and visually demonstrating range of certainty in camera-matching photogrammetry and videogrammetry.

Photogrammetry and videogrammetry are utilized in the forensic industries to accurately measure the timing, orientation, and position of objects, people, markings, or other visible entities in photographs and video footage.[1-3] This research presents a methodology for documenting and reporting the range of certainty in photogrammetric and videogrammetric techniques and demonstrates the accuracy of this methodology through analysis of four separate studies. The first study evaluates the methodology through analysis of video using body worn Camera (BWC) footage, and the second study evaluates the methodology through analysis of static camera photographs of a staged vehicle accident. Participants were provided with a camera-matched, photogrammetric solution based on a single photograph or video frame and were instructed to position and orient the 3D models of people and objects so that they were aligned to those visible in the media. These positions were compared to known object positions to determine the placement error for each object. After alignment, participants were instructed to determine a range of certainty for these positions by incrementally moving each object they had positioned toward and away from the camera and left and right of the camera path until the 3D model exceeded the extents of a reasonable match and the 3D model was no longer in alignment with the corresponding object in the media. The range of certainty determined for each object by the participants was then compared to the placement error to evaluate what percentage of error fell within the participants' range of certainty.

The accuracy of a photogrammetric solution has been shown to improve though use of multiple images recorded from different vantages.[4-6] To evaluate the effectiveness of this methodology on photogrammetric solutions with more than a single photograph or video frame, a third study was done using three video frames from BWC footage, and a fourth study was done using three still camera photographs. Participants were instructed to align 3D models so that they were consistent with all three camera matches for each study, then determine a range of certainty for each study based on complete photogrammetry solutions. To demonstrate the effectiveness of this methodology, the comparative results of these studies are reported graphically and numerically.

Reference(s):

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