C32 Assessing Agreement Among Crime Scene Measurement Methods

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Learning Overview: After attending this presentation, attendees will understand various technologies involved in crime scene reconstruction and how these different methods compare in terms of accuracy, closeness of the measurements to the ground truth value, when used for measurement.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by empowering evidence response teams to make informed decisions as to which method(s) are most suitable for a given crime scene.

A critical concern with crime scene documentation is the accuracy with which a crime scene can be reconstructed to better understand what occurred and to support any follow-on analyses. Technological advances have made it possible to have a wide array of measuring devices for the reconstruction and documentation of crime scenes, including laser-based and photogrammetric systems.[1] While all these devices are capable of accurate measurements, some may be easily influenced by environmental challenges (e.g., surface inclination, movement, humidity, temperature, vegetation, and distance) and human factors. As commercially available sensors and custom software have become cheaper and increasingly available, the more important question is how automated systems and hand-drawn methods compare in accuracy and whether this translates into additional benefits for investigators.

To compare crime scene documentation methods featuring different technologies, the accuracy of seven documentation methods as a function of measurement distance was assessed. Two methods that align well regardless of normality in their data will have better precision with respect to one another, as evidenced in relatively narrow confidence intervals and small measurement biases.[2,3] The relative accuracy of each documentation method was assessed with respect to a standard method, Total Station, from which measurements served as ground truth data.

The actual relative difference between measurements when compared to Total Station was small (less than a quarter of an inch). Measurements from FARO® Light Detection And Ranging (LiDAR) were the most comparable to those of Total Station, while a camera drone without the use of Ground Control Points (GCPs) were the least comparable. GCPs or a constrained reference scale were also found to be important in preventing increasing imprecision with increasing distance when measuring targets via drone and orthomosaic methods. Additionally, there were no statistical differences in the use of 2D (horizontal) or 3D (slope) measurement styles for the Total Station. As more measurement methods become available, and the need for training and validating new tools become a necessity, these results point to the importance of establishing a ground truth or known distance range on which crime scene measurement methods can be validated.

Reference(s):

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2. Altman D.G., Bland J.M. Measurement in Medicine: The Analysis of Method Comparison Studies. *The Statistician*. 1983. 32. 307-317.
3. Bland J., Altman D.G. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986. Feb 8; 1(8476):307-10.

Crime Scene Reconstruction, Photogrammetry, Light Detection and Ranging (LiDAR)

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