A149 Refining Data Collection Parameters for the Photogrammetric Documentation of Outdoor Skeletal Scatter Scenes: Considering Ground Surfaces

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Learning Overview: After attending this presentation, attendees will better understand the applications and limitations of documenting outdoor crime scenes using Close-Range Photogrammetry (CRP). This research focuses specifically on the comparative 3D rendering of different ground surfaces in two simulated outdoor crime scenes containing real human skeletal material.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the utility of CRP and describing how it is advantageous for application in documenting outdoor forensic crime scenes. The effects of different ground surfaces and other environmental factors that affect the 3D documentation process are also discussed.

Forensic archaeologists seek to preserve the context of the entire scene to accurately capture the taphonomic changes and reconstruct events. In archaeology, photogrammetry has been used increasingly to document scenes. However, there has been limited application in the field of forensic science. The purpose of this presentation is to refine CRP methods to use for forensic crime scene reconstructions involving human skeletal material with limited scatter of the bones on two different ground surfaces.

Digital photogrammetry relies on the systematic collection of photographs around a real-world object and computer software utilizing Structure-from-Motion (SfM) algorithms to triangulate 3D coordinates of overlapping points between two or more photographs. This documentation technique allows for the preservation of the entire 3D context and for the virtual manipulation without destroying evidence. Despite these advantages, there has been little research on the applications of CRP to the field of forensic archaeology.

For this research, two simulated crime scenes were constructed using human osteological material and clothing with minimal dispersal of the bones. These scenes were constructed at two sites on the University of Central Florida natural lands. Sites were selected for two different bottom surfaces: a mixed surface dominated by leaves, and a mixed surface dominated by grass. Prior to photography, ground foliage was cleared. Photographs were collected using a Nikon® D7200 camera and a mix of hand-held and extension pole techniques to photograph six different angles around the scene. The first five angles were photographed using the hand-held technique and the sixth angle consisted of overhead shots using the extension pole. These multiple angles have created accurate scenes with better resolution than previous research. Both scenarios were photographed using Cultural Heritage Imaging calibrated photogrammetric scales to create a scaled model. Both models were processed using Agisoft® MetaShape® Professional software. Measures of accuracy used to evaluate the models include the Root Mean Square Error (RMSE) reported by the MetaShape® software as well as visual comparison of the 3D model to the real-world scenario. Visual comparison consists of two evaluations: visual distortion around subject edges, and ground-subject interfacing issues. These are both visual errors that occur in the texture of the model.

This research demonstrates that for spatially limited and less complex scenes, photogrammetry should be integrated into the data collection protocol. Data collection parameters used in this research include both hand-held and extension pole photography techniques, clearing ground vegetation, and a total of six look angles for the models. Using these specifications, both models have final RMSE scores of less than one, indicating that they are models from which accurate measurements can be taken. Overview of the entire 3D model shows high visual and statistical accuracy. Noticeable visual distortion only occurs when the model is zoomed into scenes with highly complex geometry. In this case, the model of the bones on the surface dominated by leaves shows more visual distortion than the surface dominated by grass. Another visual complication present in the model dominated by grass is dappled shadows over the scene that may have influenced the lighting of the resulting model. Overall, CRP provides an accurate model of the positionality and context of skeletal material and should be incorporated as a methodology for the documentation protocol of outdoor forensic crime scenes.

Close-Range Photogrammetry, Outdoor Crime Scene, Complex Ground Surface

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