A148 Preliminary Investigations for Documenting Human Skeletal Remains in Obstructed Wooded Environments

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Learning Overview: After attending this presentation, attendees will better understand how Close-Range Photogrammetry (CRP) can be used to record forensic scenes in which there are human skeletal remains in obstructed outdoor environments. This presentation will focus on using CRP data collection methods to record a simulated forensic scenario constructed in an oak hammock environment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing preliminary investigations for using CRP to record scattered skeletal remains that are partially obstructed from view in a wooded environment. Building on previous photogrammetry research documenting skeletal scatters, this research will adapt these methods for obstructed wooded scenes.

Mapping and the comprehensive documentation of crime scenes are essential steps in forensic investigations. However, scenes involving human skeletal remains in wooded environments are very challenging to document. By mapping the spatial distribution of all recovered evidence, including skeletal remains, investigators may be able to recreate the scene and infer post-depositional processes. The purpose of this presentation is to demonstrate how CRP can be utilized to preserve contextual information through the creation of 3D models of forensic crime scenes involving human remains in wooded obstructed environments.

Photogrammetry is a field of study concerned with the use of photographs to obtain reliable measurements and the application of software to create 3D models. In particular, the software used in this study implements a Structure-from-Motion (SfM) algorithm to produce 3D models that allow for additional measurements or observations after the scene has been processed. While 3D modeling using CRP is frequently used to record archaeological sites, it has yet to be widely implemented in forensic settings. There are many advantages to using CRP in forensic scenarios, including recording contextual information as a 3D model that is a true-to-scale representation of the scene. Additionally, simply taking only overhead photos may not be viable for scenes in wooded environments, as individual skeletal elements may be obstructed from view. However, for CRP to become widely used for forensic scenes involving human skeletal remains, guidelines need to be further developed to generate the most accurate imagery.

Multiple iterations of a simulated forensic scene consisting of slightly scattered human skeletal material and clothing were constructed in an oak hammock environment. Data collection occurred in the natural lands of the University of Central Florida, with a ground surface consisting mainly of leaves. Remains were scattered around the bases of a few trees so that individual skeletal elements would be purposefully obstructed from view. Photographs were taken freehand using a Nikon® D7200 camera from five view angles while moving around the scene, with additional parallel overhead shots being taken with the camera attached to an extension pole. Close-up photographs of individual bones and joint surfaces were also taken. Cultural Heritage Imaging calibrated photogrammetric scale bars with coded targets were placed around the scene, and 3D models were processed using Agisoft® MetaShape® Professional.

Preliminary results of the models were very encouraging. The most important advantage of this technique was the ability to view all skeletal elements in one overhead orthophoto generated from the model. Further, the 3D models can be manipulated to view various angles and close-ups of the scene. Two tests were used to determine the accuracy of the models: the Root Mean Square Error (RMSE) and a visual assessment. All models had a RMSE of less than one, which is considered an optimal level of error for an accurate model. When viewing the entire model zoomed out, there are very few visual errors. When zoomed in, minor issues can be noted primarily along the bone edges as well as visual distortion along the interface of the bones with the ground surface.

The main limitations affecting model quality were shadows and constantly changing lighting conditions. These shadows, which are caused by surrounding trees and the photographers themselves, are unavoidable unless photographing while overcast. Additionally, the leaf ground surface proved challenging because moving around the scene during data collection occasionally disturbs the ground surface and, therefore, the model quality. While preliminary, this research generated near high-quality models with minor visual errors. However, further research is still needed to produce models with fewer distortions when zoomed in as well as to develop guidelines for documenting larger obstructed scatters.

Photogrammetry, Scene Documentation, Forensic Archaeology

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