H46 Integrating the Differential Global Positioning System and Geographic Information Systems for Mapping and Analysis of Skeletal Dispersals

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After attending this presentation, attendees will have a better understanding of the benefits of implementing the Differential Global Positioning System (DGPS) and Geographic Information Systems (GIS) in the mapping and presentation of skeletal dispersals.

This presentation will impact the forensic science community by comparing different data collection techniques using the DGPS in the mapping of a simulated skeletal dispersal and to discuss the benefits of mapping these scenes using the DGPS and integrating GIS for data analysis and presentation.

Scene mapping is an integral part of processing a scene with scattered skeletal remains. By utilizing the appropriate mapping technique, investigators can accurately document the location of human remains and maintain a precise geospatial record of this evidence and additional features at the scene. The determination of the appropriate mapping technique can be influenced by the extent of the skeletal dispersal as well as the environment. While baseline and grid mapping methods are typically used for smaller scenes, compass survey or total station methods may be used for mapping skeletal dispersals. Another mapping option is DGPS, as common units now provide decreased positional error suitable for mapping skeletal dispersals. As forensic archaeology is becoming more integrated into forensic anthropology, controlled research is essential to determine the benefits of this technology. The purpose of this presentation is to discuss the accuracy and practicality of using DGPS in mapping scattered human remains. Also, recommendations concerning data collection and the integration of DGPS scene data into a GIS will be discussed.

GPS is a satellite-based positioning system involving twenty-four satellites circling the earth. A GPS receiver uses positional information from the satellites to calculate the position on earth. A DGPS is a more accurate enhancement of a standard GPS that requires two receivers; one remains stationary while the other records positional data. The stationary receiver, a base station, relates all of the satellite measurements onto a single local reference. The base station measures the timing errors and provides correction information to the other receiver. In differential post-processing, the base station information can be obtained via the internet and then compared to the mapped point data for increased positional accuracy. The GPS geospatial data is commonly integrated into a GIS program which allows the user to display and analyze the mapped scene.

A simulated scene was assembled with a widely scattered partial skeleton in an urban environment. A Trimble GeoXH GeoExplorer 2008 Series DGPS with a Trimble Zephyr antenna, which can produce up to 10cm accuracy with post-processing, was used to map the scene. The first data collection used an average of 50 readings at one-second intervals, and the second used an average of 100 readings at one-second intervals. The data were then post-processed using GPS Pathfinder Office and exported into ArcGIS 10. After data were processed, the average corrected difference was 126.95cm for the 50-second collection time and 115.35cm for the 100-second collection time. Areas with tree cover demonstrated a corrected difference of 173.25cm for the 50-second collection time and 148.56cm corrected difference for the 100-second collection time. Areas without tree cover showed a corrected difference of 113.05cm for the 50-second collection time and 105.38cm corrected difference for the 100-second collection time. Overall, the most accurate method was using processed data with an average collection time of 100 seconds for both tree cover obstructed and unobstructed areas. However, the 50-second collection time was sufficient in unobstructed areas for mapping a skeletal dispersal. Furthermore, the distance between bones is a consideration when mapping individual bones or clusters. It is recommended to map individual features when bones are at least 25cm apart, and map clusters of two or more bones that are less than 25cm apart as one feature.

Generating GIS maps with DGPS data has numerous benefits for mapping skeletal dispersals. Aerial maps are easily added to the mapped scene data as a base layer, and site features such as trees, sidewalks, and structures can be included on the map for scene context. The DGPS software (TerraSync 3.0) also allows recording of attribute data for features through preset data dictionaries, such as bone type and side that can be accessed in a GIS using an attribute table. The user may then label the map with the desired information. Furthermore, distance between features can be easily calculated with a measuring tool. This may be useful in a court setting where the distance between bones and scene features can be easily determined while testifying.

Mapping Skeletal Dispersals, Differential Global Positioning System, Geographic Information System

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