D49 A Multidisciplinary Data Fusion-Based Approach to Remote Human Grave Detection

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After attending this presentation, attendees will appreciate the use of data fusion for remote grave detection, and will be introduced to different types of data that forensic investigators might consider when searching for clandestine burials. This presentation will demonstrate the importance of maximizing data collection opportunities for achieving both evidence- and victim identification-based goals.

This presentation will impact the forensic science community by illustrating the growing role of imagery analysis in forensic research; in particular, the characterization of unique physical grave signatures to be used in future predictive modeling studies as well as anomaly or change detection.

Social conflict poses an urgent humanitarian threat to civilians that the international human rights community would like addressed. Globally, millions of missing people are thought to be buried in clandestine graves in both active and post-conflict zones throughout the world. Having knowledge of the locations of these mass graves may inform decisions to apply political pressure to offending parties, to plan interventions to impede or even halt regional human rights violations, or to assist in reconciliation efforts. Current research involving the University of Tennessee's Anthropological Research Facility (ARF) and the Geographic Information Science and Technology Group (GIST) at Oak Ridge National Laboratory is geared toward the development of a successful approach to the remote detection of graves so investigators are better informed during the management of past and present human rights violations.

The remote detection of human graves is largely under-studied, yet many air- and space-based imaging sensors demonstrate impressive performance when used to predict, and in many cases detect, anthropogenic ground disturbance, particularly in archaeology.[1,3,4] Animal burial detection has been explored in the past by Kalacska and colleagues, who have demonstrated the potential benefit of using high-resolution spectral imagery in forensic contexts.[2] However, few other remotely sensed datasets have been tested in forensic research. Kvamme and colleagues have urged the archaeological community to combine, or fuse, data to increase the spatial, spectral, and temporal resolutions of remote sensing datasets — offering a logical argument that applies to many scientific disciplines — that data compiled from a variety of sensors and sources will paint a more complete picture of site composition and context, where physical qualities are otherwise observable as fragments in isolated datasets.[3] This research fills these data gaps by observing known human graves with a variety of sensors over several years.

A 36-month experiment is underway which strives to address the following research questions: (1) Do human graves have one or more unique signatures that can be used for grave detection?; (2) Do differently sized graves affect detection capability?; (3) Does time affect detection capability?; and, (4) What combination of sensors/signatures is optimal for grave detection?

In February 2013, ten human bodies were buried in three differently sized graves in previously unused land at the ARF. The graves contain one, three, and six bodies, respectively. A fourth grave, the control, was dug and refilled without human remains and bears the same dimensions as the six-person grave. Baseline collections of terrestrial Light Detection and Ranging (LIDAR), terrestrial spectra, aerial LIDAR, satellite multispectral, and plant samples were made before burial. Since burial, incremental collections of terrestrial LIDAR, satellite multispectral imagery, and plant samples have been ongoing and will continue throughout the study. Post-burial data collection may be expanded to include aerial LIDAR, aerial hyperspectral imagery, and field spectroscopy in the near future. Ongoing data processing and analysis is being performed under the guidance of imaging scientists at GIST, a global leader in geospatial research.

Through this research, ARF and GIST researchers aim to meet the following objectives: (1) identify one or more detectable grave signatures through the fusion of data from multiple sensors over time; (2) evaluate the sensitivity of each sensor over differently sized graves; (3) evaluate signatures of graves created at different times; and, (4) assess the utility of the remote data fusion approach in both small- and large-scale event management processes.

References:

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4. Saturno W *et al.* In: Wiseman JR and El-Baz F (eds.) *Remote Sensing in Archaeology*. Springer, 2007, pp. 137-60.

Remote Sensing, Mass Graves, Forensic Archaeology

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