D42 Hyperspectral Remote Sensing of Individual Gravesites

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After attending this presentation, attendees will better understand airborne hyperspectral remote sensing as it relates to locating clandestine gravesites including known limitations and areas that need future exploration.

This presentation will impact the forensic science community by outlining a potential new tool for detection of individual gravesites using airborne platforms, enabling coverage of a wider area than is possible using ground based detection methods such as Ground Penetrating Radar and Cadaver dogs.

The use of hyperspectral remote sensing for the detection of clandestine graves is emerging as a potential alternative tool in forensic investigations. Previous studies have demonstrated it is possible to use hyperspectral remote sensing techniques in detection of mass graves. With this study, however, the goal is to demonstrate the feasibility to utilize this same technology for the detection of individual burial sites under specific conditions.

Detection of clandestine burials is of interest to police and first responders, with cases arising from victims of crime as well as situations where no foul play is suspected, such as missing hunters and hikers. Airborne hyperspectral remote sensing enables coverage of a wider area than is possible using ground based detection methods, such as ground penetrating radar and cadaver dogs. However, as with all detection technologies, it has its limitations and a fundamental aspect of using this technology for single grave detection is to understand what these limitations are.

Detection is based on of the alteration of the environment by the body through decomposition; it essentially being a form of environmental contamination which can affect both the soil and vegetation. It is known that a decomposing body alters the surrounding environment and that the changes in the soil matrix can alter plant chemistry. The degree to which this alteration takes place is highly dependent on season, geographical location, vegetation type and the state of the body when it is buried, as well as characteristics of the body such as its weight. Due to the chemical changes in the soil, plants undergo a stress response, changing the levels of plant pigments. These changes in plant pigments have been shown to be detectable by hyperspectral sensors with mass graves. However, the case of a single grave poses a far more difficult detection problem, primarily because the body mass is much smaller than with mass graves. Furthermore, the simple question of how burial depth affects detectability and persistence of the spectral changes is unknown.

For this study, 20 pig (*Sus scrofa*) carcasses were utilized as proxies for human cadavers. The effects of three burial scenarios – surface were examined, and 30cm and 90cm soil cover (all with and without the bodies being wrapped in garbage bags) - on the detectability of single bodies (150-200 lbs each) from an airborne sensor, as well as from laboratory analyses of the spectral signatures of the soil and subsurface methane concentration and surface methane flux.

A Twin Otter with hyperspectral sensors covering the visible to shortwave infrared range sensors flew over the site and collected imagery as time and weather permitted from July - October. The two airborne hyperspectral sensors were used coincidentally to cover the 450 to 2450 nm range of the electromagnetic spectrum. In addition to the airborne sensor, a portable spectroradiometer was used to collect plant spectra in field and soil spectra in the lab.

This study compares and contrast the signatures of graves at different burial depths with and without garbage bags and discuss the influence of these two factors on the detectability of single graves using this technology. Situations in which these tools may be feasible for the location of single bodies as well as a description of the detailed calibration procedures that are required in order to adequately use such data will be discussed.

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Hyperspectral Remote Sensing, Clandestine Graves, Cadaver Detection

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