D32 Remote Hyperspectral Imaging of Human Remains

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After attending this presentation, attendees will have a better understanding of the role that remote hyperspectral imaging could play in the search for human remains.

This presentation will impact the forensic science community by providing a possible method for detecting human remains via remote sensing using hyperspectral imaging cameras that are sensitive in the shortwave region of the electromagnetic spectrum.

Human skin has been shown to possess characteristic reflectivity in the infrared region of the electromagnetic spectrum. Previous research using a hand-held short-wave infrared (SWIR) spectrometer has revealed that there are key wavelengths that can be used to distinguish skin and bone from foliage and other environmental objects. As a result, the current research study was designed to investigate the ability of an airborne SWIR hyperspectral system to detect human remains.

To determine the viability of differentiating spectral signatures of human skin from background variables, data were collected from decomposing remains at the Anthropological Research Facility at the University of Tennessee at Knoxville using portable SWIR spectrometers. Libraries of these data were developed, along with data on live human skin, and common environmental factors such as vegetation, roofing, asphalt, and other debris. Following development of the spectral libraries, principle component analysis was performed to create data models, which were subsequently tested using a soft independent modeling of class analogy (SIMCA) classification. The SIMCA results revealed that the PCA models were able to distinguish between the spectral signatures of human skin versus environmental variables. In addition, SIMCA results were used to demonstrate that live human skin and skin from human remains are spectrally similar.

Once it was determined that the categories of interest for this project were each spectrally unique in the SWIR region of the electromagnetic spectrum, the concept was applied to hyperspectral imaging (HSI). HSI allows for the collection of spatial and spectral data simultaneously, creating a "data cube" which can be used to chemically classify objects in an image. The spectral profile collected for each pixel contains reflectance data characteristic of the material or combination of materials present in that location in the image. By processing the hyperspectral images using commercial image analysis software, spectra in the image can be matched to reference spectra, allowing for the detection and visualization of specific substances or objects.

Tests using an airborne hyperspectral system (400-2350nm) have been completed. A small human remains sample was placed on the ground along with live skin subjects, various test materials, and debris. Hyperspectral images were obtained at altitudes ranging from 200-1500 ft from a helicopter hovering over the target area. Using reference spectra, each image was calibrated and atmospherically corrected. The Spectral Angle Mapper (SAM) classification method was used to match spectral library data from skin to spectra from the airborne images. The reference spectra were successfully matched to spectra within the images, and the corresponding pixels were then classified and illuminated accordingly. These results suggest that airborne hyperspectral imaging can be used to remotely detect human remains. **Remote Sensing, Hyperspectral Imaging, Human Remains**

 ** Presenting Author*