A189 Hyperspectral Imaging of Post-Blast Explosives Residues

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The goal of this presentation is to provide attendees with an introduction to the theory and practice of hyperspectral image analysis and its potential for use in examining post-blast explosives residues.

This presentation will impact the forensic science community by demonstrating the significance of using hyperspectral imaging to locate, identify, and characterize trace chemical evidence, such as post-blast explosives residues, which might otherwise be overlooked or destroyed in a crime scene investigation. In addition, the determination of a standard protocol for fixed, in-laboratory hyperspectral imaging of post-blast explosives residues will be both novel and necessary for the advancement of the technique within the field of forensic science. The goal of the authors is to adapt the protocol determined in the current study for use in airborne hyperspectral imaging systems, which would allow for large- scale imaging of crime scenes where the presence of post-blast explosives residues is questioned.

Identification of key wavelengths for analysis of post-blast explosives residues in the visible-near infrared (VNIR) and shortwave infrared (SWIR) regions of the electromagnetic spectrum will be made using a handheld point spectrometer with a tungsten halogen source. During each sample analysis, the spectrometer automatically measures reflectance over a set spectrum of wavelengths. For every sample scanned, the spectrometer obtains and averages five readings to account for error. Spectroscopic analysis of post-blast explosives residues will allow for the construction of a spectral library of “clean” samples. The spectral library will provide a point of comparison between post-blast samples and a previously assembled spectral library of pure explosive samples, as well as provide a possible means for identifying unknown post-blast residues at a crime scene. In addition, key wavelengths for post-blast explosives residues identified by the spectrometer will allow for a focused study of both “clean” and questioned samples using two hyperspectral imaging camera systems (VNIR and SWIR, respectively).

While the point spectrometer is beneficial for its portability and general ease of use, the fixed hyperspectral imaging camera systems provide a much higher level of spectral resolution and control of external conditions. For each pixel in an image, a hyperspectral camera acquires the intensity of light (radiance) for a large number of contiguous spectral bands. Every pixel in the image therefore contains a contiguous spectrum (in radiance or reflectance) and is used to characterize the objects in a scene. One narrow spatial line in the scene is imaged at a time and this line is split into its spectral components before reaching the sensor array. On the 2D sensor array, one dimension is used for spectral separation and the second dimension is used for imaging in one spatial direction. The second spatial dimension is obtained by scanning the camera over a scene or object. The result can be seen as one 2D image for each spectral channel or simply stated, every pixel in the image contains one full spectrum.

Preliminary results confirm the ability of the handheld spectrometer to detect post-blast explosives residues on a metal substrate. While low- reflectance (i.e., black) samples such as some of the low explosives, are not ideal samples for analysis using the point spectrometer, results have been obtained from several high explosive samples. The present focus of this study is the optimization of production and collection of “clean” post- blast explosives residues for analysis by both the point spectrometer and the hyperspectral imaging cameras. Once these methods have been determined, key wavelengths for explosives samples can be established and used to construct a spectral library.

Preliminary results confirm the ability of the hyperspectral imaging camera systems to detect post-blast explosives residues on a metal substrate. Initial results indicate that the key wavelengths for the detection of these samples may exist in the VNIR region of the electromagnetic spectrum.

Hyperspectral Imaging, Explosives, Post-Blast Residues

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