A9 Hyperspectral Imaging Provides Easy Detection and Visualization of Biological Stains

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After attending this presentation, attendees will understand the basic principals of hyperspectral imaging and how it compares to conventional methods of detection, visualization, and examination of biological fluid evidence on various types of substrates.

This presentation will impact the forensic community by introducing a new method for capturing and enhancing images of biological fluid evidence.

At most crime scenes, biological evidence is present in various forms. Human biological fluids, blood, semen, and saliva are of particular interest to the forensic examiner. The ability to utilize these fluids to make critical forensic links between the victim(s), accused, items of evidence, and the crime scene are unquestionably significant. The significance of biological fluids can never be realized without first being able to locate them on substrates in a non-destructive manner. With bloodstain patterns we not only need to locate the stains but there is a need to be able to visualize the physical characteristics of the stain patterns to assess their entire forensic value. The physical characteristics of the bloodstain patterns can provide the examiner with information as to how the bloodstains were deposited onto the substrates. This information can assist with establishing whether a crime was committed, what type of crime was committed, where the crime was committed and who may have committed that crime.

The locating of biological fluid evidence can be challenging. Conventionally, searching for and capturing biological fluid evidence is performed by visually scanning the evidence with light sources such as, high intensity lights and an alternate light source (ALS). Often, different types of excitation wavelengths and colored goggles or barrier filter combinations are attempted in order to maximize contrast between the biological fluid and the substrate. Searching for bloodstains on dark, patterned or otherwise interfering substrates is especially difficult. These substrates unquestionably inhibit our ability to assess the physical characteristics of bloodstain patterns.

In this study, two methods of imaging biological fluid samples were evaluated based on the technologies' ability to detect, discriminate, and categorize the samples, as well as provide images with strong sample-to-substrate contrast. The first method of examination is visual inspection and digital photography. This method involves using various excitation wavelengths and barrier filter combinations, chosen based on educated information regarding the emission, absorbance, or reflectance properties of the fluid of interest. The second method of biological fluid sample examination is hyperspectral imaging. Hyperspectral imaging combines digital imaging technology with conventional spectroscopy for evidence analysis. It provides high spatial resolution, high image definition, and full spectrum analysis. In operation, digital images of the sample are recorded as a function of wavelength through the use of an electro-optic imaging spectrometer, generating a fully resolved spectrum for each pixel location in the multi-frame image. The combined spatial and spectral information reveals subtle features of a material that, often, cannot be observed using traditional imaging techniques.

Pure biological samples (blood, saliva, and semen) were deposited onto various substrates, including dark colored cloth and plastic, light colored cloth and plastic, and patterned cloth. The samples were examined using both technologies. The results demonstrate the strengths and weaknesses of each methodology, including the ability of each to produce images with maximum sample to substrate contrast and stain pattern visualization.

Hyperspectral Imaging, Bloodstains, Digital Photography

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