J23 The Use of Hyperspectral Imaging for Ballpoint Pen Ink Differentiation

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After attending the presentation, attendees will have an understanding of the discriminating power of hyperspectral imaging (HSI) methodologies, as related to ballpoint pen ink differentiation.

This presentation will impact the forensic science community by providing guidelines for HSI reflectance and luminescence data collection, as both methods have been shown to provide increased discrimination capabilities as compared to other imaging technologies currently available to forensic document examiners.

Ink discrimination can be further enhanced by employing more sensitive techniques and equipment. Visible/near-infrared (NIR) reflectance and luminescence can be a major asset to the forensic document examiner, providing the means for both nondestructive and chemistry-based analysis. HSI combines both spectroscopic and digital imaging information by recording images of the samples as a function of wavelength through the use of a highly efficient electro-optic imaging spectrometer. When liquid crystal tunable filters (LCTF) are employed during data collection, one is able to achieve a finer spectral resolution as well as more detailed spectra to reveal small spectroscopic variations within a given sample. HSI provides visible and NIR data as well as high resolution images that equip examiners with the tools to detect small chemical variations amongst a set of given inks.

In this study 44 black ballpoint pens were paired in various combinations and then were analyzed with the goal of determining HSI's ability to detect, discriminate, and provide satisfactory sample to sample (as well as sample to substrate) contrast. The samples were also previously examined using VSA (video spectral analysis) and LAB Color Mode. Over 500 samples were studied using reflectance/absorbance and luminescence modes, to exploit several spectroscopic properties for each pen pair. The overall results from the study will be discussed, including potential sources of error, as well as a general comparison of the performance of HSI to other techniques used to analyze the pen pair samples. The research aims to demonstrate how HSI can be utilized by document examiners in daily casework as well as ultimately show the analytical capabilities HSI has for discriminating black ballpoint pen inks.

Hyperspectral Imaging, Ballpoint Pen, Ink Discrimination

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