B17 Forensic Discrimination of Ink Samples Using UV/Visible Microspectrophotometry and Multivariate Statistics

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After attending this presentation, attendees will understand improvements in forensic document examinations for casework studies.

The designed experiments performed in this research, combined with analytical discrimination achieved among inks on questioned documents, will impact the forensic community and/or humanity by suggesting improvements in forensic document examinations for casework studies.

The goal of this presentation is to determine the usefulness of UV/visible microspectrophotomery (MSP) and multivariate statistics to discriminate between similarly colored ink samples.

This research addresses the needs of forensic document examiners to discriminate between ink samples written on questioned documents. The examination of questioned documents often includes separation, identification, and quantitation of the ink deposited onto paper during the writing process. The diverse chemical structures of colorants and other components in ink provide a chemical basis for the ability to discriminate and identify their characteristic component materials. Frequent issues include determining the age of the writing/document, whether the same pen was used on two different documents, whether multiple entries were written at the same time, or whether a document was altered. Ball point, fountain, felt tip, and gel pen inks have different compositions and properties. Inks are mixtures of a wide range of chemical compounds that include cationic or anionic colorants and a liquid portion known as the “vehicle.” The vehicle (solvents, waxes, resins, and oils) aids in the flow and drying characteristics of the ink as it leaves the pen. Driers, plasticizers, greases, soaps, and detergents may be added to the ink and vehicle for other desired characteristics. In matching a questioned writing sample to a standard ink, the identities and concentrations of the ink components, along with the vehicle and other components that solubilize the ink, can provide a molecular “fingerprint” of the ink.

Samples from various brands of black, blue and red ink pens were collected to test the ability of UV/visible microspectrophotometry to discriminate pen inks. This study involved ball point and gel ink pens only. Ink samples from the same pen, from pens of the same exact type, and from pens of similar color but containing different chemical components were also included in the experimental design. One microliter of ink was sampled from each pen with a pipette, dissolved in 10 microliters of methanol, dispersed onto a microscope slide, and dried before analysis. Ink samples were also extracted from ink on documents and analyzed in the same manner to test differences that might arise in inks on paper and as a result of aging on the document. The MSP was operated in transmission mode using a xenon source and a 35X collecting objective. Characterization of ink samples using UV/visible microspectrophotometry offers simple, direct, non-destructive analysis of ink on questioned documents. Spectra of selected ink samples were analyzed using principal component analysis and linear discriminant analysis. These multivariate statistical tools facilitate the visualization of differences among spectra and the identification of spectral features that differentiate ink samples from one another.

The designed experiments performed in this research, combined with analytical discrimination achieved among inks on questioned documents, may suggest improvements in forensic document examinations for casework studies.

Document Examination, Multivariate Statistics, Ink Analysis

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