Abstracts

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A Study on the Levels of Difficulty in the Simulation of Individual Characteristics in a Signature
(Gek-Kwee Lee, Bei-Sing Yap, Chiew-Yung Yang, Lee-Tiang Lee, Sock-Kim Tan, and Koon-Puay Tan)

This study looks at the levels of difficulty in simulating a signature with respect to 12 selected individual characteristics in a model signature. The objective was to find out which of these features in the signature were relatively easy or difficult to simulate and to compare the results with those expected based on the team's knowledge and experience in forensic handwriting and signature examination. Sixty-two volunteers took part in the study. The results of the analysis show that the experimental data is generally in agreement with the expected relative levels of difficulty of the characteristics studied. This study provides good evidence that the principles and knowledge applied in forensic handwriting and signature examination are sound and reliable and that characteristics in a person's signature are individualized.

Limited Populations – Are They Feasible for Handwriting Examinations?
(Chris Anderson, BSc and Julian Leslie, PhD)

The term *limited population* refers to an examination involving a small number of potential writers who could have written a questioned document containing a very limited number of characters. An investigation was undertaken to ascertain the impact a limited population of writers would have on identifying the actual writer. Two simple statistical models were used in this study. Unsurprisingly, the chance of identifying the writer reduces as the number of potential writers increases. However, this reduction became quite marked for certain values of quantities used in the models. The quantities of relevance were the number of key distinguishing features in the writing and 2 probabilities—1 associated with incorrectly deciding that a character was not written by the writer of the questioned document and the other associated with correctly identifying a character as not written by a person who did not write the questioned document.

Capillary Electrophoresis of Ballpoint Pen Inks
(James M Egan, Jason D Brewer, Kristin A Hagan, and Cheryl L Strelko)

Two capillary electrophoretic (CE) methods have been designed to differentiate and identify organic and inorganic dyes present in black and blue ballpoint pen inks. CE was chosen because the technique provides chemical information that can provide better discrimination between ink formulations than thin-layer chromatography (TLC) when comparing ink samples during document analysis. One CE buffer was designed to separate and analyze 10 blue ballpoint pen ink formulations. An alternative buffer was designed to separate and analyze 15 black ballpoint pen inks and 2 different inkjet cartridge products from the same manufacturer. The capillary detection method using a photo-diode array (PDA) to acquire absorbance data (190-600 nm) provides lambda max (λ_{max}) and characteristic UV-Vis spectra for analytes. Simultaneous spectral data collection avoids the necessity for densitometry measurements. Mobility values (μ_{ep}) calculated from a migration time replace hand-measured TLC R_f values. The sample electropherograms are reproducible with 2 μg/mL concentration limits of detection, which is superior when compared to TLC separations. Specific chemical identification can be determined based on spectral and mobility value match to reference dye standards. All inks were differentiated from one another in the respective category (blue, black, or inkjet formulation). When possible, chemical compounds were identified in a particular ink to aid characterization. CE offers additional advantages over TLC, including lower reagent consumption, smaller sample requirements, lower detection limits, quantitative analysis, method automation, direct reference comparison, electronic data storage, and searchable spectral libraries. Other complimentary techniques (TLC, positive- and negative-ion mode electrospray-ionization mass spectrometry) can be performed because little sample (20 nL) is consumed for CE analysis. The same CE buffers formulated for ballpoint pen inks have been applied to color inkjet printer formulations, food dyes, gel pen inks, and textile dyes.

Using TLC and GC-MS to Determine Whether Inks Came from the Same Manufacturing Batch
(Valery N Aginsky)

Gas chromatography-mass spectrometry (GC-MS), being a well proven analytical method of determining the qualitative composition of multi-component systems, is effective for the analysis of inks, most of which are complex mixtures of chemical compounds. A combination of thin-layer chromatography (TLC), which analyzes ink colored components, and GC-MS, which analyzes ink noncolored components, demonstrates high discriminating power with regard to writing inks that can be distinguished neither by nondestructive techniques nor by TLC. Case examples are considered in which coupling of TLC and GC-MS allowed one to discriminate between ink indistinguishable by TLC and to determine that the inks on questioned documents came from the same manufacturing batch.

Micro-Raman Spectroscopy of Color Inkjet Printed Documents
(Williams David Mazzella, MS; Adrien Mathieu, MS; and Patrick Buzzini, MS)

Inkjet printed documents produced by 22 different brands and models of color inkjet printers available on the Swiss market were analyzed by micro-Raman spectroscopy using a near infrared (NIR) excitation wavelength of 785 nm. The magenta components were discriminated into 11 groups, but the cyan inks could not be further distinguished. The yellow inks did not exhibit significant Raman scattering; however, the cyan inks could not be further distinguished. The yellow inks did not exhibit significant Raman scattering, but the signals may have been concealed due to strong interference from the paper background.