

Instrumental and Statistical Methods for the Comparison of Class Evidence

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Instrumental and Statistical Methods for the Comparison of Class Evidence

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Abstract:

Trace evidence is a major field within forensic science. Association of trace evidence samples can be problematic due to sample heterogeneity and a lack of quantitative criteria for comparing spectra or chromatograms. The aim of this study is to evaluate different types of instrumentation for their ability to discriminate among samples of various types of trace evidence. Chemometric analysis, including techniques such as Agglomerative Hierarchical Clustering, Principal Components Analysis, and Discriminant Analysis, was employed to evaluate instrumental data. First, automotive clear coats were analyzed by using microspectrophotometry to collect UV absorption data. In total, 71 samples were analyzed with classification accuracy of 91.61%. An external validation was performed, resulting in a prediction accuracy of 81.11%. Next, fiber dyes were analyzed using UV-Visible microspectrophotometry. While several physical characteristics of cotton fiber can be identified and compared, fiber color is considered to be an excellent source of variation, and thus was examined in this study. Twelve dyes were employed, some being visually indistinguishable. Several different analyses and comparisons were done, including an inter-laboratory comparison and external validations. Lastly, common plastic samples and other

polymers were analyzed using pyrolysis-gas chromatography/mass spectrometry, and their pyrolysis products were then analyzed using multivariate statistics. The classification accuracy varied dependent upon the number of classes chosen, but the plastics were grouped based on composition. The polymers were used as an external validation and misclassifications occurred with chlorinated samples all being placed into the category containing PVC.

Description:

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