Spectroscopic Detection of Latent Fingermark Residue for Forensic Applications

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Abstract
Spectroscopic methods have emerged as rapid, non-contact, non-destructive tools with strong potential for detecting diverse forms of trace evidence. Among such evidence, fingermarks can directly associate a scene with an individual because friction ridge skin is both individually distinctive and stable over time; accordingly, forensic practice centers on comparing ridge characteristics across Levels 1–3 to support robust identification. Fingermark residue primarily comprises eccrine, sebaceous, and apocrine secretions, with additional exogenous constituents acquired through routine activities. In this study, we investigated the fluorescence signatures of natural, uncontaminated, intact fingermarks. Fingermarks from donors were deposited on glass microscope slides, and multiple regions across each impression were systematically mapped and analyzed to identify the dominant endogenous fluorophores. We then constructed a composite fluorescence spectrum by combining the emissions of these contributors, yielding a comprehensive spectral signature of each fingermark impression. The resulting composite provides a compact, component-informed representation of fingermark chemistry that can be leveraged for non-contact detection and comparative assessment. Understanding the intrinsic fluorescence of natural fingermarks establishes a foundation for improving scene-level detection strategies and for extending this approach to contaminated or environmentally challenged impressions.