E57 Morphometrics of the Aging Process of Latent Fingerprints

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After attending this presentation, attendees will have an inside view of the latest research on latent fingerprint degradation processes based on measurable visual parameters.

This presentation will impact the forensic science community by demonstrating the feasibility of the technique used for determining aging patterns.

For many years, scientists focused on understanding the nature of latent fingerprints as well as improving and developing visualization techniques and reagents on different surfaces following exposure to a range of environmental conditions. In the 21st century, a suspect not only needs to be placed at a scene, but the timeframe in which this valuable evidence was deposited needs to be determined.

The reliability of latent fingerprints frequently arises in court when the fingerprints cannot be directly correlated to the moment a crime was committed. A methodology that could determine, as precisely as possible, the time a latent fingerprint was deposited would be of great value to law enforcement and the courts. Such a methodology would provide the ability to more accurately place a suspect within the timeframe of an alleged crime beyond any subjective witness or victim statements. Timing is crucially important in penal cases to further strengthen the probative value of any evidence in either exonerating or incriminating a suspect. Intensive research is being conducted globally to determine the age of latent fingerprint depositions on different surfaces. Unfortunately, many approaches usually involve expensive equipment and complex techniques that are time consuming and require great expertise by highly skilled researchers.

The present study summarizes the conclusions of a five-year proof-of-concept project that set the foundation for an empirical, inexpensive, and quantitative method to establish the aging process of latent fingerprints. This method is based on the observation of certain morphometric changes (degradation parameters) caused by monitored indoor environmental factors. This approach consists of determining, as precisely as possible, a fingerprint's age in which the sole requirement is a common powder developer used in the field (i.e., titanium dioxide). The proposed method is easy to apply, inexpensive, and does not require sophisticated forensic techniques or scientific expertise.

This study revealed visual patterns of degradation which are highly dependent on the environmental conditions monitored. Factors considered include temperature, relative humidity, air currents, type of fingerprint depositions (sebaceous-rich and eccrine-rich), various exposures to natural daylight (direct, penumbra, and darkness), and type of substrate (glass and plastic) over a continuous period of six months. The morphometric approach generates statistical data from the quantifiable analysis of four visual parameters of degradation commonly observed in the progression of a fingerprint aging process: (1) width of ridges; (2) color contrast between ridges and furrows; (3) number of ridge discontinuities; and, (4) number of viable minutiae. Preliminary data allow the discrimination of the aging processes of fingerprints exposed to different environmental conditions with unique aging patterns for each fingerprint.

The most significant results to date can be summarized as: (1) the number of minutiae remains unchanged over time for fingerprints exposed to direct light but varies for other conditions; (2) color contrast is a good estimate of degradation but requires observing the color histogram profile together with the Mean/Standard Deviation (SD) for a correct interpretation; (3) the width of ridges remains relatively stable over time, increasing or decreasing depending on the combination of factors; and, (4) the number of ridge discontinuities alone is not informative and requires normalization by combining with another parameter, specifically, the level of visual quality (clarity) of ridge features. Generally, exposure with direct light has not shown a significant effect on the four parameters for sebaceous samples on glass. Contrary to common belief, this supports the concept that fingerprints are not always better preserved in the dark. Further, the highest variability in minutiae count is observed on plastic substrates.

The age of fingerprints could be included as a new step in the examination process to increase the robustness and reliability of evidence; however, this method needs to be further developed by exploring aging patterns from different powder developers and donors as a function of time. In the near future, the proposed scientific method could strengthen the probative value of criminal evidence while saving laboratory costs, reduce the number of suspects wrongly convicted or exonerated, and minimize annoyances to people inadvertently associated with a crime scene.

Latent Fingerprints, Aging, Parameters