**Interpol Review of Fingermarks and other Body Impressions 2016 – 2019**
**Executive Summary of the following INTERPOL publication:**
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**ASCLD Forensic Research Committee**
**Future Forensics Subcommittee**

**Interpol review of fingermarks and other body impressions 2016–2019 (Summarized by Henry Swofford)**

- There is a strong push from the scientific community towards the adoption of transparent, data supported, probabilistic reporting framework instead of the traditional categorical reporting. Emerging capabilities responsive to this include:
    - A pattern classification scheme was proposed serving as a basis to assign evidential weight to fingerprint general patterns when visible on marks [22].
    - The development and validation of software, FRStat, used by the U.S. Department of Defense was provided [25]. This software is now used operationally by fingerprint experts at the Defense Forensic Science Center, and their reports account for that statistical value [26]. The computed metric has been commented to reduce a large source of variability—inter-examiner variability in decision making—in the latent print analysis process [27].
    - The performance of a score-based likelihood ratio system using the algorithm of an AFIS system was presented showing substantial evidential strength for same source comparisons that do not meet "identification" thresholds [28].
    - A system to model fingermark distortion and provide an early detection of potential misattribution was proposed as a means of improving quality assurance [32].
    - A statistical model to support the latent print examination workflow by predicting whether a mark should be searched in AFIS or not based on quantity of information and automated quality assessment of features was proposed [33].

- There is some growing interest related to the ability of experts to opine in relation to the activities that led to the deposition of the detected marks. Preliminary research has shown the position, direction, area, and location of marks can be used, along with a Bayesian Network [74].

- There has been increasing focus on effective means of articulating conclusions from fingermark comparisons and lay interpretation; studies to estimate general rates of error for fingermark comparisons, and strategies related to policies and procedures proposed to improve practice and reduce error potential. A full summary can be found by reference to Section 2.3 – 2.4, pgs. 3 – 5 of the Interpol Review [references 34 – 90]).

- There has been increasing focus on measuring the performance of experts compared to novices and development of perceptual expertise. Of particular interest is that the accuracy of trainee fingermark examiners was found to improve considerably within the first three months of training, then plateaued after this time [97]. This suggests shorter and more targeted training schemes can be considered compared to multi-year processes before being signed off for casework examination.

Latent Print Composition:

- There have been a wealth of studies related to preliminary/pilot studies dedicated to analyzing fingermark composition. Many refer to unconventional approaches or are based on limited sets of fingermarks, are preliminary in nature and not yet ready for operational consideration; thus, caution should be taken with regards to some expressed conclusions. A full summary can be found by reference to Section 3.1, pgs. 7 – 9 of the Interpol Review [references 184 – 222]). Select research topics include:
    - Evolution of secretion residue with time
    - Age estimation for deposited fingermarks
    - Donor profiling, e.g. lifestyle inferences based on chemical assessments of exogenous compounds in fingermark residue

Fingermark detection:

- Studies related to fingermark detection were expansive, consisting of over 300 articles published related to fingermark detection and imaging/recording. Select topics of research focus and potential capabilities include nanoparticles in suspension, dusting of micro-sized particles, chemical imaging, and contaminated fingermarks. Similar observations were made in the 2013-2016 report showing trends related to security matters (explosive- and drug-contaminated fingermarks) and the technical specialization linked to fingermark detection and imaging/recording. Unfortunately, this technological leap continues to suffer from the absence of follow-up studies, the need for overspecialized equipment requiring specific abilities, and a failure to account for forensic considerations such as the absence of integration into operational procedures.

- Studies related to traditional fingermark detection techniques focused on evaluating performance characteristics under various environmental conditions, substrate varieties, application sequences, and substitute ingredients. These studies added to the general body of knowledge and reference when faced with specific case-circumstances or evidence types but did not propose novel near-implementation ready methods to advance operational capabilities in traditional forensic laboratories. Early pilot evaluations on several substrates include:
    - Adhesives and tapes – Optical coherence tomography is proposed to image fingermarks beneath adhesives without requiring their removal from the surface they adhere.
    - Banknotes – Vacuum metal deposition (copper based mono-metallic) combined with NIR observation represents a promising way to detect fingermarks on UK polymer banknotes.
    - Metal and cartridge cases – Various approaches were proposed to detect fingermarks on cartridge cases or other metallic surfaces, using a variety of molecular complexes, co-electrodeposition of metallic particles, gel-based electrolytes, etc.
    - Skin and leather – simultaneous fuming of cyanoacrylate and iodine on leather is proposed to detect marks on leather.
    - Thermal papers – vacuum sublimation of lawsone or brief immersion in hot water (the latter being destructive to the sample with low performance on aged marks).
    - Blood containing fingermarks – Various approaches were proposed to detect fingermarks containing blood, using nanoparticles in suspension, water soluble

benzalole dyes, orthophenylenediamine and Zar-Pro strips, or aggregation induced emission involving serum albumin and tetraphenylethene maleimide.
    - Contaminations (other than blood) – Various approaches were proposed to detect contaminates in fingermarks without ridge pattern imaging, using hyperspectral SRS to image exogenous compounds in spiked fingermarks (i.e. gun powder and benzoic acid), PS-MS to detect illicit drugs in spiked fingermarks or from fingermarks left by drug users, IR laser ablation coupled to vacuum capture and MALDI-MS to detect caffeine and condom lubricant in spiked fingermarks, etc.

- A full summary can be found by reference to Section 3.2, pgs. 9 – 28 of the Interpol Review [references 224 – 556]).

<u>Other Body Marks</u>:

- Other body impressions represent a small minority of research in the forensic literature. Examples include cheiloscopy, external ear anatomy, and variability of barefoot impressions. Unfortunately, these are far from the type of extensive research that would be needed to satisfy the strong requirements set by PCAST. A full summary can be found by reference to Section 4, pg. 28 of the Interpol Review [references 570 – 588].

<u>Selected References of Interest</u>:

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