E55 Identification of Originator Attributes From Fingerprints Via Chemical Assays

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After attending this presentation, attendees will understand that fingerprints can be used as more than just a picture for comparison and can be used for identifying certain attributes of the fingerprint originator based solely on the composition of the fingerprint content. Attendees will also learn that there are various methods that can be used for this type of analysis.

This presentation will impact the forensic science community by providing new methods for the analysis of fingerprints in order to generate essential information about suspected individuals directly at a crime scene. This concept will provide a simple yes/no response within minutes to confirm originator attributes. In addition, these systems can potentially be incorporated into field-deployable devices (similar to glucometers) or connected to hand-held smartdevices that will allow rapid analyses that can be used and interpreted by operators with no scientific training.

Fingerprinting was introduced to the field of forensic science more than a century ago and has since become common practice for identification purposes; however, this area has seen minimal improvements since its establishment; it has stalled at simple visual comparison and matching, even though fingerprints — as samples of biological origin analogous to blood — have the potential to provide much more information. Currently, only the shape, size, and unique patterns associated with fingerprints are compared using various computational programs, which continues to be a time-consuming process that requires an expert's opinion. While this method is fairly well established, it is not applicable for all situations. For instance, when only partial or smudged fingerprints are collected, a match is unlikely to be found.

In addition to the situations mentioned above, one of the greatest setbacks in fingerprint analysis is that if a matching fingerprint is not saved in a database or if the person of interest is not physically present for comparison, the print is reduced to merely exclusionary evidence, despite being stored in a separate database for future use with newly obtained fingerprints. The same can be said about DNA. Even though DNA can provide the most significant information about the fingerprint originator, DNA analysis can take weeks or months. Additionally, only a few nanograms of DNA at most can be recovered from a fingerprint as the majority is lost during collection and extraction. Ultimately, even if DNA was collected, it is possible that a matching profile may not exist.

The purpose of the proposed approach is to address the issue of a fingerprint being partial or smudged as well as the issue of not having an immediate matching image or DNA profile. It has recently been demonstrated, using bioaffinity-based enzyme cascades and chemical assays, that the amino acid content in fingerprints can be used to differentiate between male and female fingerprints. The research displayed here further investigates the use of straightforward chemical assays instead of the more complex biochemical assays. Chemical tests are fairly well

known, especially in the field of forensic science where there are field kits that are used for the on-site analysis of drug samples. The most common tests for illicit substances are Marquis, Simon's, and Chen's tests.

As with any multi-analyte system (enzymatic or chemical), it is possible for multiple amino acids to correspond to the same attribute, which can, therefore, compromise the overall results. To eliminate this possibility, it is pertinent that there be systems developed that are restricted to one analyte (amino acid) or a specific combination of analytes that are correlated to the desired originator characteristics. To insure that the methods presented here are practical and can be used on samples left on more than one particular surface, research demonstrating the performance of the system on samples collected from various surfaces is also provided.

The developed chemical assays also have the potential to be coupled with a portable apparatus for use directly onsite where the assay can subsequently be performed and the results interpreted by non-scientific personnel. This can be conducted in a manner that is similar to water test kits and the VOCkit system, which is a small strip that has a grid of several dozen indicator chemicals imprinted on it that is used by the Army for the detection of threat agents, such as anthrax, sarin and mustard gas.

Fingerprints, Identification, Forensics