G93 Structured Light Illumination (SLI) Capture of Postmortem 3D Fingerprint Point Coordinates

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The goal of this presentation is to introduce the audience to Structured Light Illumination (SLI) Capture and its potential application to the process of postmortem identification of decomposed remains.

This presentation will impact the forensic science community by introducing the potential application of SLI Capture to the process of postmortem identification of decomposed human remains, thereby effecting a more rapid identification of unidentified bodies, potentially increasing the solve rate for homicides.

The identification of unidentified human remains in the nation's medical examiners' and coroners' offices has been called a silent epidemic. Many of these cases remain open due to a failure to associate a putative identification between a known set of remains and a missing person. Technology such as the National Missing and Unidentified System (NamUS) protocol have been utilized toward the end of increasing the number of leads between bodies and specific missing subjects. Once associations have been made, screens allow specific identification between subjects to variable degrees of certainty, based on the methodology employed. All methods of identification have limitations: dental is scientific but relies on proper records; DNA is highly reliable but time-consuming and expensive; fingerprints are reliable but require known prints; and so forth. All methods are adversely impacted to varying degrees by decomposition. One of the earliest postmortem changes with decomposition is loss of useful fingerprints on a set of remains. This may occur with loss of printable surface as a result of slippage of the epidermal glove, distortion by prolonged water submersion, desiccation through mummification, etc. In many instances, visible fingerprint information is present but not forensically useful for identification purposes due to the inability to accurate collect, utilize, and maintain such data. Many of these unidentified remains are homicide victims and the lack of or delay in victim identification adversely impacts law enforcement investigative efforts, lowering the total number of cases solved.

In an effort to find a possible solution to the issue of obtaining fingerprints in cases where conventional efforts are difficult, impractical, or impossible, a prototype digital screening process for the examination and comparison of low-quality postmortem fingerprints was created. The system employed utilized a SLI technology to capture the full three-dimensional point coordinates of the fingerprints with a native resolution of ~1,000 pixels per inch (ppi) with a final flattening resolution and uniform spacing of 500 ppi. SLI uses a series of projected light patterns captured at an angle by a camera. The distortion of the patterns off the target surface is used to calculate the surface point coordinates in three-dimensional. SLI methodology is well-established in research and industrial applications. Within biometrics and forensics, SLI has allowed direct measurement of the fingerprint ridges on living subjects. For postmortem fingerprint capture, the SLI technique captures the surface topology and ridge patterns via penetration of the light patterns and interference with structures within the tissue

The prototype instrument was deployed into an operational medical examiner's office, with cases selected on a prospective basis. Inclusion criteria were based on gross examination of the remains' fingers by a single pathologist in determining whether or not the system might be useful to enhance otherwise suboptimal fingerprints. Optical scans were conducted and digitally stored for subsequent single-blinded comparison by a certified latent fingerprint examiner.

Preliminary results document that useful postmortem fingerprints can successfully be utilized for identification purposes in cases where conventional techniques may not be as effective. Benefits of the system include the potential for increased identifications based on the inexpensive, easy, rapid, and reliable methodology of postmortem fingerprints. An additional benefit is that fingerprinting can be conducted without physically contacting the decedent's body, thus preserving potential trace evidence while allowing scientific confirmation of identification prior to autopsy examination. Miniaturization of the prototype will allow such processes to be conducted on scene, before a body is transported. The hope is that, ultimately, increasing rapidity of identification will expedite case investigation in homicides and improve solve rate.

Structured Light Illumination, Decomposition, Fingerprints

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