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**Forensic Science – Biology, Biology – Biochemistry**

***Analysis of the Color Contrast between Ridges and Furrows of Latent Fingermarks Within a Small Population***

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There has been limited research on population studies regarding age of latent fingermarks on non-porous surfaces. Scientists are exploring possible ways of estimating time of deposition, with occasional investigations into population studies. Establishing a method for age determination is important for general processes involving fingermarks. This correlates into assisting in analyzing marks within a population. This research will be influential to standardizing a technique of identification in the near future. In a previous study, color contrast was defined as the average difference in intensity of pixels between valleys and ridges in a fingermark. This research tested a method for quantification of color contrast in a fingermark by using different scanners and the histogram function in Adobe® Photoshop®. It was found that the type of scanner used significantly affected contrast measurements. Intra- and inter-rater reliability was tested and it was determined that the method of quantification did not differ within or between raters (1). Another study was conducted examining the color contrast of enhanced latent fingermarks to estimate degradation levels. This research tracked ridge-furrow color contrast over time by studying environmental variables such as substrate (deposition surface) and secretion (sweat type). The aging study found sebaceous secretions on glass were most resistant to the various elements. The researchers examined histogram profiles taken from Adobe® Photoshop® and paired the results with statistical analyses performed using the statistical program R, to which substrate and secretion type were both determined to be statistically significant (2).

This SURF research aimed to determine if there was a difference in color contrast within fingermarks of males and females. Other variables accounted for were powder type (white or black), substrate (plastic or tile), generation (first or second touch) and impression (flat or rolled). Another question the research aimed to answer was whether this technique was reproducible and sensitive enough to detect the differences expected. The original 240 JPEG images were obtained from a library of prints, coded and randomized to minimize bias during data collection. Color contrast values depicted in the histogram obtained from ImageJ were defined as brightness levels 0 (pure black) – 255 (pure white). The y-axis of the histogram represented the frequency of pixels within the selected tonal range. The images were modified to greyscale, converted to 3000 pixels per inch and resized to 1 cm x 1 cm. The white color of the ruler label in the image was standardized to a value of 180 by adjusting the midtone of the image using the Levels function in Adobe® Photoshop®. The mean intensity, intensity amplitude (range of colors) and other histogram data was recorded for each image using Adobe® Photoshop® and ImageJ and transferred into Microsoft Excel and IBM® SPSS® Statistics for

statistical analyses. A total of three replicates were performed along with a validation protocol taken from a previous investigator.

The technique of color contrast examination was found to be reproducible both within and between investigators as well as over different conditions. No significant differences could be detected between sexes on inked or latent fingerprints. About latent prints, a significance was detected between powder type as well as between substrates. This can be attributed to the nature of the black and white powders in that they are opposite colors. The difference between substrate types may be caused by an interaction between the print and the substrate, and the fact that the tiles were originally red in color. Regarding inked prints, no significant difference was detected between deposition types. This can be due to the technique not being sensitive enough to distinguish differences between flat or rolled prints. A significant difference was detected between generation as the first impression after inking is darker than a second impression without re-inking. This results in a noticeable decrease in contrast. We plan to publish these results in conjunction with the blind study titled “The Use of Color Contrast to Detect Biological Sex Differences in a Small Population of Fingerprints,” also prepared during SURF 2019 by another student.

#### Citations

1. Matuszewski, S. and Szafałowicz, M. (2013), A Simple Computer-assisted Quantification of Contrast in a Fingerprint. *J Forensic Sci*, 58: 1310-1313. doi:10.1111/1556-4029.12224
2. De Alcaraz-Fossoul, J., Barrot Feixat, C., Tasker, J., McGarr, L., Stow, K., Carreras- Marin, C., Turbany Oset, J. and Gené Badia, M. (2016), Latent Fingerprint Aging Patterns (Part II): Color Contrast Between Ridges and Furrows as One Indicator of Degradation. *J Forensic Sci*, 61: 947-958. doi:10.1111/1556-4029.13099