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Skin Topography Analysis for Forensic Application

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Introduction

Since fingerprints are not always available for analysis, alternative mechanisms to use prints from other topographical regions must be explored. In previous studies done by alumni, human skin topography was found to repeat in unique patterns over time. This project ascertains the accuracy of image recognition software in studying changes in skin topography of forensically relevant regions over time.

Objectives

This project strives to design and use a MATLAB image processing code capable of accurately recognizing unique topographical features of skin topography at the following forensically relevant locations: the anterior forearms, the dorsal side of the hands, and above the radial pulse on both wrists. The project also endeavors to assess the longevity of a print's usefulness in identifying a subject and improve the understanding of challenges involved with using skin topography of various regions as a means of identification.

Methodology

1. Develop feature recognition code.
2. Lay imaging region in a flat, relaxed position.
3. Mark imaging zone and image.
4. Repeat Steps 1-3 every week.
5. Compare images to Week 1 and track changes over time.

References

[1]Mathworks. (2017). Object Detection in Cluttered Scene Using Point Feature Matching. *Mathworks*.

Results

Figure 1: Skin Topography Similarities Over a One Week Time Lapse

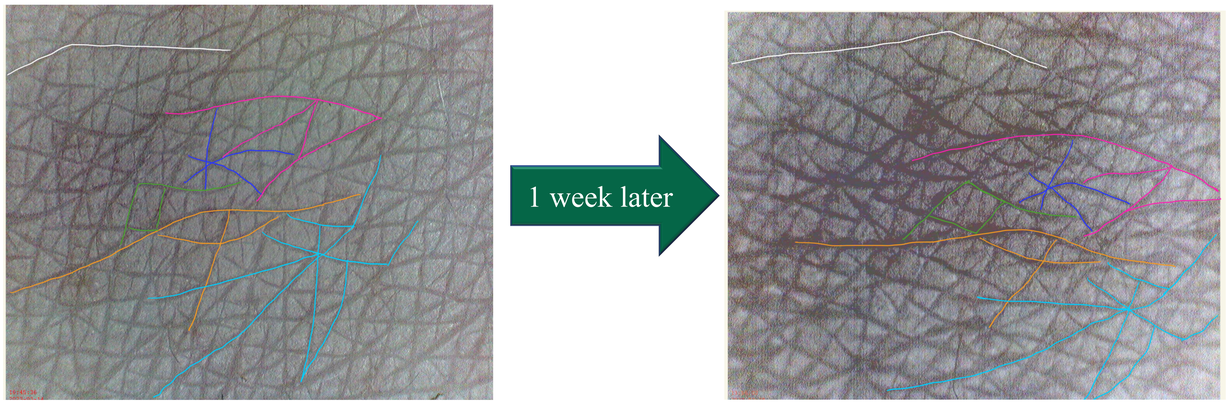

Figure 1: Two skin topography images of dorsal side of right hand of the same subject taken during Week 1 (left), and Week 2 (right). Colored annotations mark corresponding topographical similarities.

Figure 2: Negative Control of Matched Points Between Two Images of Skin Topography on the Dorsal Side of the Right Hand

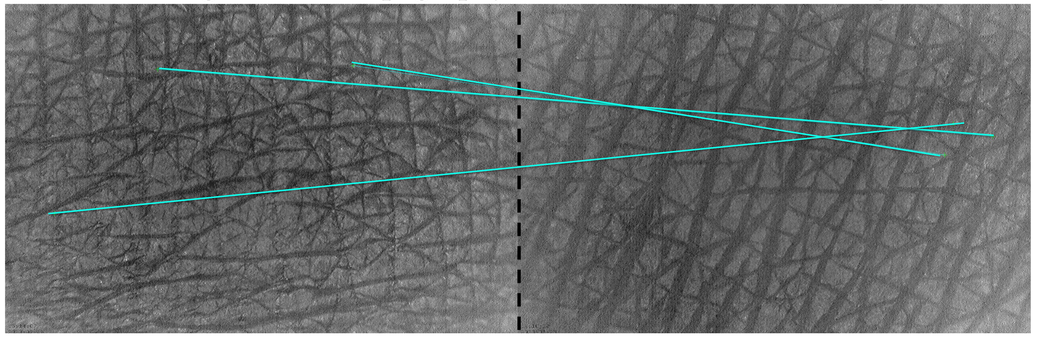

Figure 2: Two skin topography images of dorsal side of right hand of the same subject taken during Week 1 (left) and Week 3 (right). The black dotted line separates the two images. The blue lines mark topographical similarities.

Figure 3: Positive Control of Matched Points Between Two Images of Skin Topography of the Left Anterior Forearm

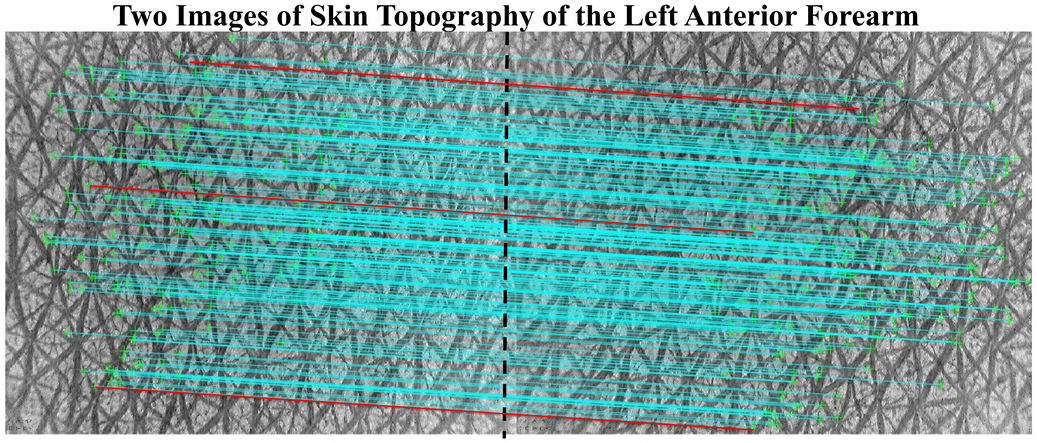

Figure 3: A transformation test of two skin topography images of left anterior forearm of the same subject taken on the same day. The black dotted line separates the two images. The blue lines mark corresponding topographical similarities, and the red lines highlight some similarities for easier viewing. A total of 209 similarities were found.

Testing Metrics

"Successful matches" between two images are determined by MATLAB, must surpass the determined match threshold, and are checked by qualitative observation. The match threshold is the average amount of correct matches in a data set. Images will be taken of subjects every week for approximately two months.

Expectations for Results

The pulse region is expected to exhibit slower topographical change than the other two imaging regions and may not exceed match threshold due to flexion changes. Topography on dorsal side of hands is anticipated to change more rapidly than the other two imaging regions which suggests a shorter longevity of identification usefulness for prints at this region. Prints of anterior forearm topography is likely to have the longest longevity usefulness since it is in a lower risk region for wounds and topography changes may come at a slower rate. Therefore, the collective feature matches at the anterior forearms may have a higher chance of exceeding match threshold than the other the other two regions.

Future Direction

Next steps include conducting topography analysis on five volunteers over approximately two months and determining if prints from one imaging region have a longer longevity usefulness than prints from the other two regions.

Acknowledgements

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