

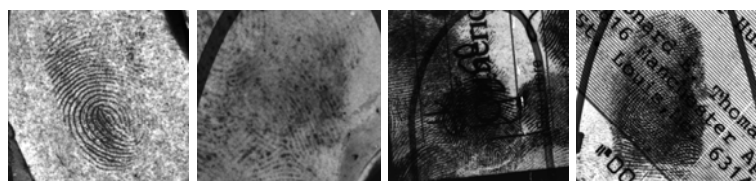
Abstract

Fingerprints have been used to identify persons for almost 100 years. One of the irreplaceable functionality of fingerprint recognition is its capability to link partial prints, called latents, found at crime scenes to suspects whose fingerprints are previously enrolled in a fingerprint database. Due to their poor quality, automatic feature extraction and matching of latents are challenging problems. We have proposed a semi-automatic latent enhancement algorithm to provide visually enhanced latents to examiners for manual markups and improve automatic matching performance.

Latent Fingerprint Matching

Latent Fingerprint

- ❑ Lifted from surface of objects that are touched by a person
- ❑ Extremely useful in forensics to investigate crime scenes
- ❑ Latents have poor quality compared to rolled prints



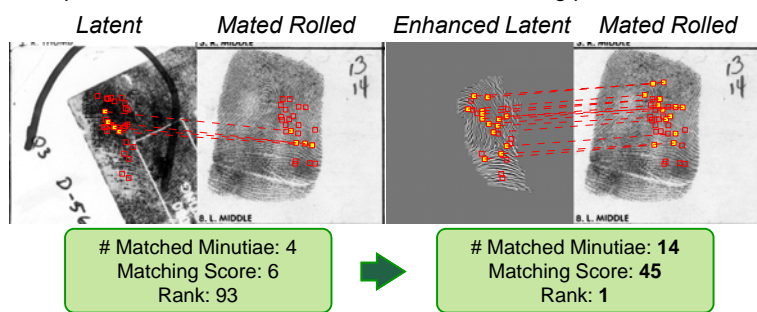
Partial area Unclear ridge Overlap with other fingerprints Complex background

Current Practice in Latent Fingerprint Matching

- ❑ Due to poor quality of the latents, automatic feature extraction is a challenging problem.
- ❑ Latent examiners manually mark minutiae (ridge bifurcations and endings) and additional detailed features such as pores, dots and incipient ridges.
- ❑ Latents with manually marked minutiae are matched against the fingerprint database using an automatic matcher.
- ❑ Examiners verify top-N candidates to confirm genuine match.

Latent Fingerprint Enhancement

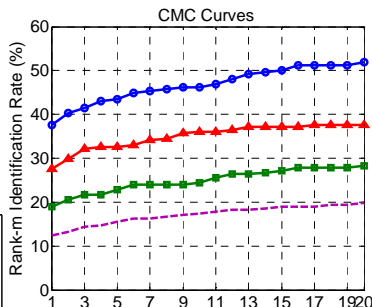
- ❑ Provide better quality latents to examiners for manual markup
- ❑ Improve automatic feature extraction and matching performance



Experimental Results and Conclusions

- ❑ Latent Database: 258 images in NIST SD27
- ❑ Reference Database: 27,258 rolled prints from NIST SD27 (258) and NIST SD14 (27,000)
- ❑ Matcher: Neurotechnology VeriFinger SDK 4.2

- Latent enhanced with marked OF
- △— Latent enhanced with estimated OF, RANSAC
- Latent enhanced with estimated OF, LS
- No enhancement

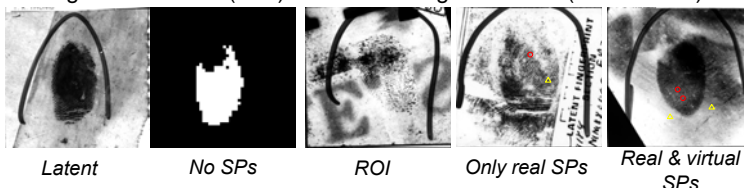


- ❑ Conclusion: Proposed latent enhancement scheme improves the matching performance of commercial fingerprint matcher.

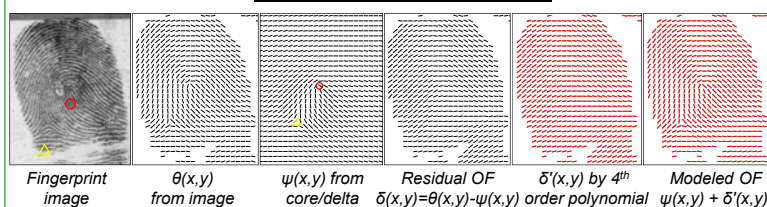
Robust Orientation Field Estimation

Manual Markups

- ❑ Region of Interest (ROI)
- ❑ Singular Points (Real/Virtual)

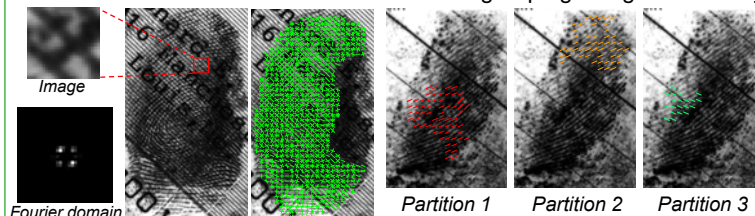


Orientation Field Model



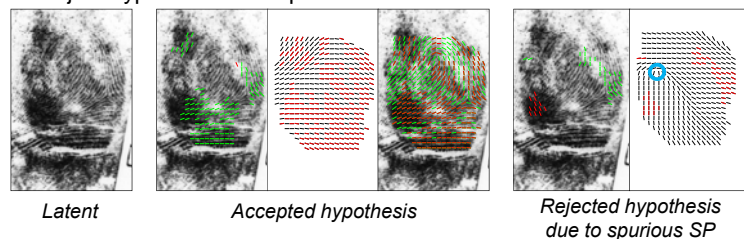
Initial Orientation Field Estimation

- ❑ Short Time Fourier Transform
- ❑ Local grouping using consistency

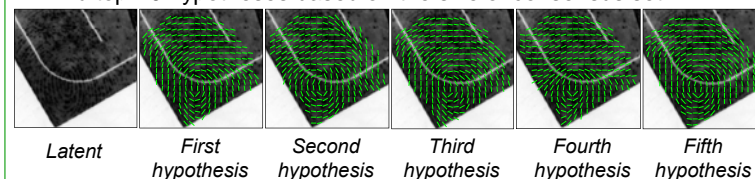


Orientation Field Regularization Using R-RANSAC

- ❑ Randomized RANSAC
 - s: minimum # of data points to build a model
 - Step 1. Choose initial ridge flow partitions, S, such that $|S| > s$
 - Step 2. Build a hypothesis
 - Step 3. Test the hypothesis
 - Reject the hypothesis if all partitions in S are not inliers. Go to step 1.
 - Otherwise, add a new partition in S. Go to step 2.
- ❑ Reject hypothesis with spurious SPs



- ❑ Find top-10 hypotheses based on the size of consensus set



Enhanced Latent Fingerprints

