FINGERPRINT RECOGNITION FOR FORENSIC APPLICATIONS

Ph.D Thesis by Ram Prasad Krishnamoorthy (2015)

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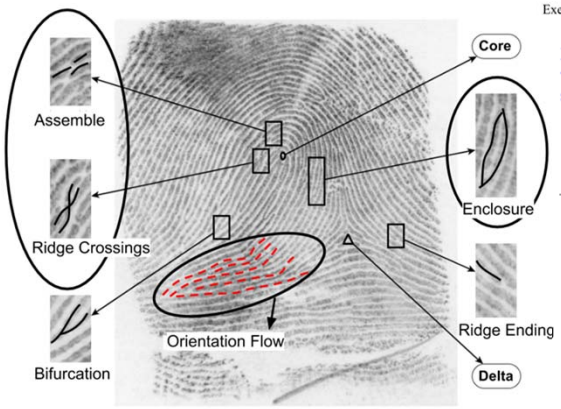
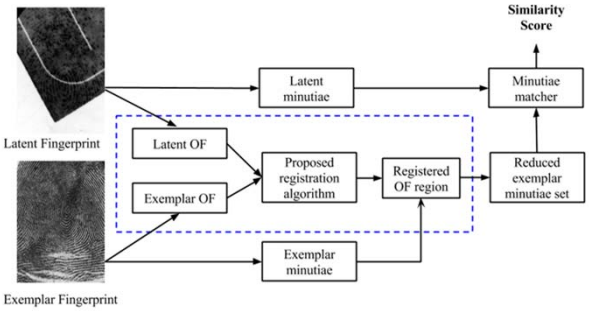
THE THESIS

When comparing a partial fingerprint minutiae pattern against a full fingerprint minutiae pattern, it is advantageous to pre-align the partial pattern in the full pattern so as to reduce the matching error, thereby improving the identification accuracy. Additionally, together with the typical automatically extracted minutiae, the use of reliably extracted Extended Feature Sets for fingerprints also helps in improving both the identification accuracy and the computation of Likelihood Ratios for statistical evidence evaluation.

Types of Fingerprint features

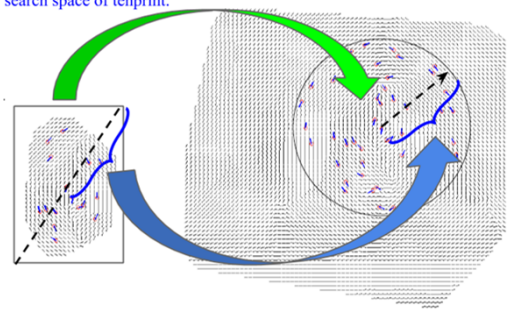


Partial fingerprint registration using orientation field

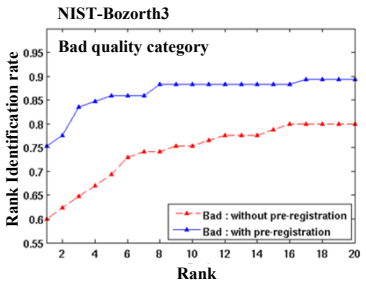


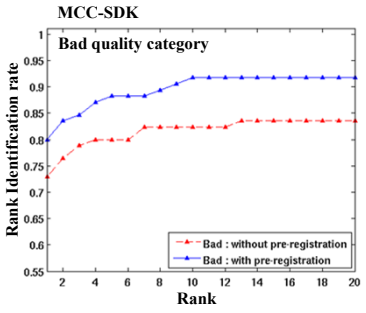
By registering the partial OF and full OF, we were able to reduce the minutiae search space of tenprint.

Radius of circle relative to latent size.



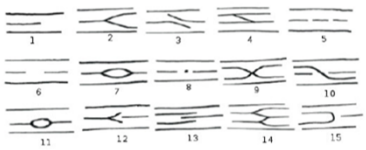
Results on NIST Special Database 27





Quality	NIST-Bozorth3 DIRECT(%)	NIST-Bozorth3 with L2(%)	MCC-SDK DIRECT(%)	MCC-SDK with L2(%)
All	68.60	78.29	78.29	80.62
Good	77.27	85.23	96.59	95.45
Bad	60.00	75.29	72.84	80.00
Ugly	68.24	74.12	64.71	65.88

Guardia Civil Database (GCDB)



Rare minutia features in GCDB

No	Minutiae type	No	Minutiae type	No	Minutiae type
1	Ridge Ending	6	Interruption	11	Circle
2	Bifurcation	7	Enclosure	12	Delta
3	Deviation	8	Point	13	Assemble
4	Bridge	9	Ridge Crossing	14	M-structure
5	Fragment	10	Transversal	15	Return

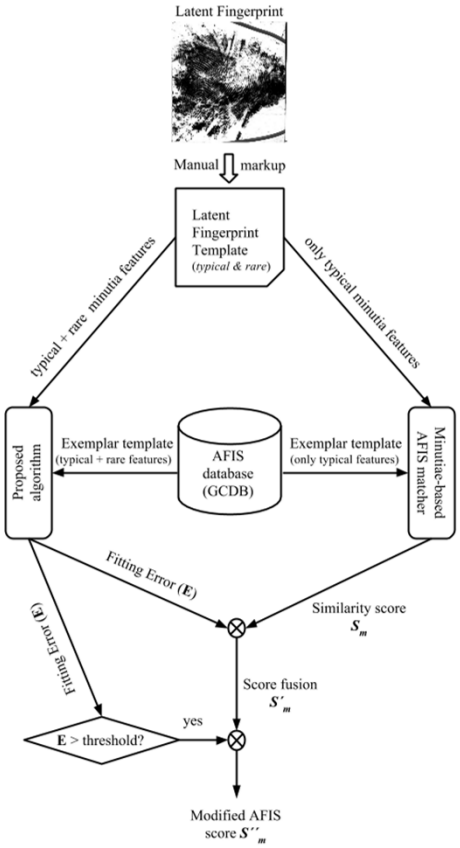
Statistics of typical and rare minutiae in GCDB

No	Minutiae Type	Probability (p_i)
1	Ridge-ending	0.5634
2	Bifurcation	0.3620
3	Deviation	0.0015
4	Bridge	0.0024
5	Fragment	0.0444
6	Interruption	0.0021
7	Enclosure	0.0204
8	Point	0.0036
10	Transversal	0.0003

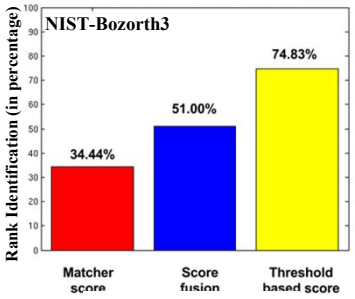
92% of minutiae are typical features.

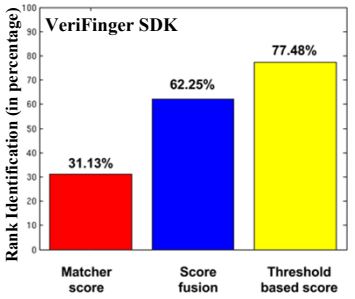
8% of minutiae are only rare features.

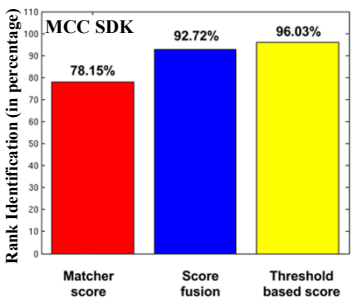
Incorporating rare minutiae in typical minutiae-based matchers



Results on GCDB (Rank-1)







Key publications

- R. P. Krish, J. Fierrez, D. Ramos, J. Ortega-Garcia and J. Bigun, "Pre-Registration of Latent Fingerprints based on Orientation Field", ***IET Biometrics***, pp. 1-11, January 2015.
- R. P. Krish, J. Fierrez, D. Ramos, F. Alonso-Fernandez and J. Bigun, "Improving Automated Latent Fingerprint Identification using Extended Feature Sets" (*under review*)
- R. P. Krish, J. Fierrez, D. Ramos, "Integrating Rare Minutiae in Generic Fingerprint Matchers for Forensics", in *Proc. 7th IEEE Intl. Workshop on Information Forensics and Security*, Rome, Italy, 2015.
- R. P. Krish, J. Fierrez, D. Ramos, J. Ortega-Garcia and J. Bigun, "Pre-Registration for Improved Latent Fingerprint Identification", in *Proc. 22nd IAPR Intl. Conf. on Pattern Recognition*, Stockholm, Sweden, 2014.
- R. P. Krish, J. Fierrez, D. Ramos and R. Wang, "On the importance of rare features in AFIS-ranked latent fingerprint matched templates", in *Proc. 47th IEEE Intl. Carnahan Conf. on Security Technology*, Medellin, Colombia, 2013.