

# Local Features for Enhancement and Minutiae Extraction in Fingerprints

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## Abstract

Accurate fingerprint recognition presupposes robust feature extraction which is often hampered by noisy input data. We suggest common techniques for both enhancement and minutiae extraction, employing symmetry features. For enhancement, a Laplacian-like image pyramid is used to decompose the original fingerprint into sub-bands corresponding to different spatial scales. In a further step, contextual smoothing is performed on these pyramid levels, where the corresponding filtering directions stem from the frequency-adapted structure tensor (linear symmetry features). For minutiae extraction, parabolic symmetry is added to the local fingerprint model which allows to accurately detect the position and direction of a minutia simultaneously. Our experiments support the view that using the suggested parabolic symmetry features, the extraction of which does not require explicit thinning or other morphological operations, constitute a robust alternative to conventional minutiae extraction. All necessary image processing is done in the spatial domain using 1D filters only, avoiding block artifacts that reduce the biometric information. We present comparisons to other studies on enhancement in matching tasks employing the open source matcher from NIST, FIS2. Furthermore, we compare the proposed minutiae extraction method with the corresponding method from the NIST package, mindtct. A top five commercial matcher from FVC2006 is used in enhancement quantification as well. The matching error is lowered significantly when plugging in the suggested methods. The FVC2004 fingerprint database, notable for its exceptionally low quality fingerprints, is used for all experiments.

## Index Terms

Image Enhancement, Fingerprint Restoration, Minutiae Extraction, Parabolic Symmetry, Linear Symmetry, Symmetry Features, Image Pyramid, Differential Scale Space, Orientation Tensor, Fidelity

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