Fingerprint Orientation Field Estimation Using ROEVA (Ridge Orientation Estimation and Verification Algorithm) and ADF (Anisotropic Diffusion Filtering)

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Abstract The goal of this paper is to offer a joined approach in fingerprint orientation field estimation, integrating some of the most known techniques like ridge orientation estimation and image filtering, both tested using images from local and public databases. We propose a reliable orientation estimation algorithm [6] and anisotropic image filtering in this paper. To show the applied theory experimental results, we use Matlab for our implementation of the above algorithms. The investigation results showed robustness improving the correct estimation of the fingerprint ridge orientation process.

Keywords Fingerprint · Fingerprint enhancement · Orientation estimation · Orientation enhancement · Anisotropic filtering

1 Introduction

Correct estimation of fingerprint ridge orientation is an important task in fingerprint image processing. A successful orientation estimation algorithm can drastically improve tasks performs such as fingerprint enhancement, classification, and singular point extraction. Gradient-based orientation estimation algorithms are widely adopted in academic literature [4], but they cannot guarantee correctness of ridge orientations.

Fingerprints are the most important biometric identifier and are widely applied in automated fingerprint identification systems, used in large-scale civil identification

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projects. Fingerprint image consists of alternating pattern of ridges (dark area) and valleys (white area) [7], where ridges denoted by the black curves and valleys are the spaces between two neighbor ridges, see Fig. 1. These directional patterns from various fingerprint features, including singular points (delta and core), represents regional directional makeup and randomly distributed local discontinuities called minutiae (such as ridge end, and bifurcation).

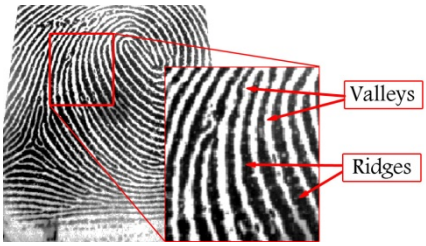

Fig. 1 Fingerprint image.

Developing a reliable fingerprint orientation estimation algorithm [6] is critical to creating a directional field from a fingerprint. A directional field denote the representation of ridge orientations, usually in square blocks, from the original fingerprint; generally used in fingerprint classification and singular points recognition.

The fingerprint orientation estimation algorithm performance is greatly influenced by the image quality, a correct orientation field is important to an Automated Fingerprint Identification System [9] see Fig. 2.

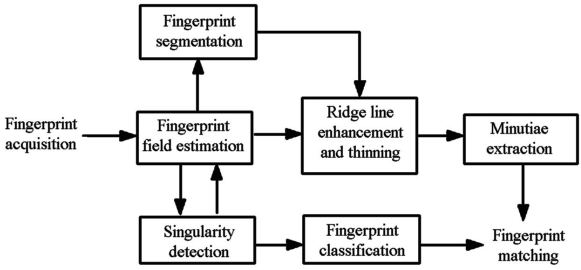

Fig. 2 Automated Fingerprint Identification System (AFIS).

2 Anisotropic Diffusion

The first phase of our approach consist in image enhancement by anisotropic diffusion, this algorithm anisotropically diffuses an image. That is, it blurs over regions of an image where the gradient magnitude is relatively small (homogenous regions) but diffuses little over areas of the image where the gradient magnitude is large.