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Combining weighted linear project analysis with orientation diffusion for fingerprint orientation field reconstruction

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Abstract: This paper presents a novel algorithm for reconstructing the fingerprint orientation field (FOF). The basic idea of the algorithm is to reconstruct the FOF by combining weighted linear project analysis with orientation diffusion. We first compute the weight values of point gradients according to the similarity of point orientations. In the second procedure, the qualities of blocks are assessed by the coherence of point orientations, and then the block orientation with high quality are estimated by the weighted linear projection analysis based on the vector set of point gradients. The fingerprint blocks that will be reconstructed is selected by the priority of them in the third procedure. In the end, the FOF is reconstructed by orientation diffusion based on the reconstruction priorities of blocks. To validate the performance, the proposed method has been applied to fingerprint enhancement, fingerprint singularity detection, fingerprint minutiae extraction and fingerprint matching using the FVC 2000 and FVC2004 databases. The experiments show that the proposed method is more accurate and more reliable, and it is more robust against noise.

Keywords: Fingerprint orientation reconstruction; Weighted linear projection analysis; Quality assessment; Orientation diffusion

1. Introduction

Over the past years, the technology of digital image processing has been widely used in all kinds of fields [38, 39, 43]. In the recent years, with the increasing concern about security, the biometrics based on digital image processing has been widely investigated for personal recognition by using one or several physiological or behavioral characteristics such as fingerprint, face, palmprint and so on [25, 26, 30, 40]. The accurate automatic personal identification is critical in a wide range of applications such as smartcards, commercial services, airport security and automated banking. Among all the biometrics, the fingerprint recognition technology is one of the most popular technologies for personal identification because of its convenience, uniqueness and invariance. The human fingerprints are believed to be unique [30]. In general, an automatic fingerprint identification system (AFIS) usually works by extracting and matching fingerprint minutiae [13, 31]. A typical AFIS often consists of the fingerprint acquisition, the fingerprint preprocessing (such as the fingerprint segmentation, the orientation field estimation and the

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