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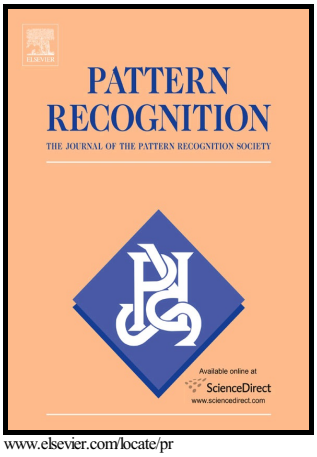

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Singular value decomposition and local near neighbors for face recognition under varying illumination

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Abstract:

Illumination processing is a challenging task in face recognition. Although numerous techniques have been proposed to tackle this problem, none of them can achieve high performance under different illumination variations. In this paper, we propose three closely related illumination processing techniques to address different illumination variations. First, we employ singular value decomposition (SVD) bases with frequency interpretation and corresponding contribution coefficients (i.e. normalized nonlinear singular values) to obtain the high-frequency facial features of a face image in logarithm domain, which is termed as the high-frequency SVD face (HFSVD-face). Moreover, we propose the adaptive HFSVD-face (AHFSVD-face), which adaptively selects a special nonlinear parameter to generate HFSVD-face according to the face image illumination level. The illumination level of a face image is estimated by its singular values. Second, we construct the local near neighbor feature (LNN-feature) based on the local region, which is an illumination invariant measure. Then the discriminative weights (DWs) and Gaussian weights (GWs) respectively combine with several LNN-features to generate the fusion LNN-feature (FLNN-feature), which can be named as DWFLNN-feature and GWLNN-feature. The bipolar sigmoidal function removes the high-frequency interference of FLNN-feature to form LNN-face (including DWLNN-face and GWLNN-face). Third, we develop the H&L_SVD as a preprocessing technique, which consists of the normalized low-frequency components and the corrected high-frequency components divided by SVD. And then the illumination insensitive measure can be extracted from H&L_SVD by LNN-face to robustly tackle the face image with sever illumination variations. The performances of the proposed methods are verified using Yale B, CMU PIE, LFW and our self-built driver face databases. The experimental results indicate that the proposed methods can obtain high performances under different illumination variations and outperform several state-of-the-art approaches which are proposed to address face recognition under varying illumination.

Keywords: Illumination processing; Singular value decomposition; Illumination level; Local near neighbors; Joint illumination processing