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算法研究

基于非下采样Contourlet变换的光照不变量提取算法

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摘要:

人脸识别作为一种非接触式、友好的生物特征识别技术，在军事、公安、经济等领域具有广阔的应用前景。近年来，人脸识别技术取得了很大进展，涌现出许多优秀的人脸识别方法，许多人脸识别系统表现优异。但是，人脸识别仍是一个没有彻底解决的难题，光照变化是其中关键问题之一。2006年FRVT测试结果表明光照变化会严重影响自动人脸识别系统的识别性能。为了消除光照变化对人脸识别的影响，提出了一种基于非下采样Contourlet变换的光照不变量提取算法。首先，对图像进行光照归一化，预先减弱光照变化对人脸识别的影响；其次，进行对数变换和非下采样Contourlet变换，得到低频分量和高频方向子带分量；再次，低频分量进行直方图均衡化以进一步减弱光照的影响，高频分量进行自适应NormalShrink阈值去噪处理；最后利用处理后的低频和高频方向子带分量进行逆非下采样Contourlet变换，提取到光照不变量，作为后续的识别依据。为验证算法性能，本文在Yale B 和CMU PIE 人脸库上做了对比实验，结果表明：本文方法提取的光照不变量具有较强的鲁棒性，能够大大提高任意光照情形下的人脸识别率。

关键词： 人脸识别；光照变化；光照不变量；非下采样Contourlet变换；NormalShrink；图像去噪

Illumination Invariant Extracting Algorithm Based on Nonsubsampled Contourlet Transform

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Abstract:

Face recognition, a non-contact and friendly biometric identification technology, has broad application prospects in the military, public security and economic security. Related research in recent years has made great progress, a number of excellent face recognition algorithms have emerged, and a number of face recognition systems have achieved good performance. However, many issues still remain to be addressed and illumination changes remain one of the major challenges for current face recognition systems. The report of FRVT 2006 shows that varying illumination will seriously affect the performance of face recognition. In order to eliminate the effect of varying illumination on face recognition, a novel illumination invariant method based on nonsubsampled Contourlet transform is proposed. Firstly, we perform illumination normalization on images under varying illumination, which can reduce the effect of varying illumination to some extent. Secondly, the logarithmic transformation and the nonsubsampled Contourlet transform is used to decompose the images into its low frequency and high frequency directional subband components. Thirdly, adaptive NormalShrink is applied to each directional subband to eliminate noise, and the histogram equalization is applied to the low frequency components aimed at weakening the illumination affects further. Lastly, the illumination invariant is obtained by inverse nonsubsampled Contourlet transform using the modified low frequency components and high frequency directional subband components. Experimental results on the Yale face database B and CMU PIE database show that the proposed method can effectively eliminate the effect of varying illumination on face recognition and the obtained illumination invariant is robust.

Keywords: face recognition； illumination； illumination invariant； nonsubsampled Contourlet transform； NormalShrink； Image denoising

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