

论文与报告

基于大间距准则和图像矩阵双向投影的人脸特征提取方法

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摘要

传统基于降维技术的人脸特征提取需要将图像转换成更高维的向量, 从而加剧维数灾难问题, 对于采用 Fisher 优化准则的特征提取, 这也会使小样本问题更加突出. 基于图像的矩阵表示, 本文提出了一种新的基于大间距准则和矩阵双向投影技术的人脸特征提取方法(Maximum margin criterion and image matrix bidirectional projection, MMC-MBP). 该方法一方面在计算散度矩阵时引入了能保持数据局部性的 Laplacian 矩阵, 以保持数据的流形结构, 从而提高识别正确率; 另一方面采用了有效且稳定的大间距的优化准则即最大化矩阵迹差, 能克服利用 Fisher 准则所带来的小样本问题; 更重要的, MMC-MBP 方法给出了求解最优双向投影矩阵的迭代计算过程, 该迭代求解过程能保证目标函数的单调递增性、收敛性以及投影矩阵的收敛性, 从而成功解决了传统基于张量(矩阵)投影技术的特征提取方法特征维数过高或者无收敛解的问题. 最后广泛而系统的人脸识别实验表明, MMC-MBP 的迭代求解过程能很快收敛, 且相比 Eigenfaces, Fisherfaces, Laplacianfaces 等脸识别方法, 具有更高的识别正确率, 是一种有效的人脸特征提取方法.

关键词 [特征提取](#) [维数约简](#) [大间距](#) [人脸识别](#)

分类号

Face Feature Extraction Based on Maximum Margin Criterion and Image Matrix Bidirectional Projection

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Abstract

Conventional appearance-based face recognition needs to convert the image matrix into a higher dimensional vector. This will aggravate "the curse of dimensionality" problem and small sample size problem for those who adopt Fisher discriminant criterion. Moreover, existing feature extractions based on tensor (matrix) representation of image encounter the problem that dimensionality of extracted feature is still too high or there is no convergent solution. Based on matrix representation of image and matrix bidirectional projection, a novel feature extraction method called MMC-MBP (maximum margin criterion and image matrix bidirectional projection) for face recognition is proposed. On the one hand, since the Laplacian matrix, which can preserve the locality of the data set, has been introduced into the scatter matrix, MMC-MBP can preserve the intrinsic manifold structure of face set. On the other hand, MMC-MBP adopts an efficient and stable maximum margin criterion, so it can conquer the small sample size problem brought by Fisher discriminant criterion. What is more, an iterative procedure, which is proven to be convergent and can monotonously increase the objective value, is devised to compute the optimal projection matrices. Thus, the proposed MMC-MBP approach can conquer the problem of existing tensor (matrix) projection based feature extraction approaches. Extensive and systematic experiments on CMU PIE face database and Yale face database verify the high convergence speed of the iterative solution procedure and demonstrate that the proposed MMC-MBP outperforms the state-of-the-art methods in face feature extraction such as Eigenfaces, Fisherfaces, and Laplacianfaces.

Key words [Feature extraction](#) [dimensionality reduction](#) [maximum margin](#) [face recognition](#)

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