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长论文

Fisher线性鉴别分析的理论研究及其应用

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摘要
Fisher线性鉴别分析已成为特征抽取的最为有效的方法之一. 但是在高维、小样本情况下如何抽取Fisher最优鉴别特征仍是一个困难的、至今没有彻底解决的问题. 文中引入压缩映射和同构映射的思想, 从理论上巧妙地解决了高维、奇异情况下最优鉴别矢量集的求解问题, 而且该方法求解最优鉴别矢量集的全过程只需要在一个低维的变换空间内进行, 这与传统方法相比极大地降低了计算量. 在此理论基础上, 进一步为高维、小样本情况下的最优鉴别分析方法建立了一个通用的算法框架, 即先作K-L变换, 再用Fisher鉴别变换作二次特征抽取. 基于该算法框架, 提出了组合线性鉴别法, 该方法综合利用了F-S鉴别和J-Y鉴别的优点, 同时消除了二者的弱点. 在ORL标准人脸库上的试验表明, 组合鉴别法所抽取的特征在普通的最小距离分类器和最近邻分类器下均达到97%的正确识别率, 而且识别结果十分稳定. 该结果大大优于经典的特征脸和Fisherfaces方法的识别结果.

关键词 Fisher鉴别准则 线性鉴别分析 Foley-Sammon线性鉴别分析 组合线性鉴别分析 高维小样本问题 人脸识别

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Theory of Fisher Linear Discriminant Analysis and Its Application

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Abstract
In high-dimensional and small sample size case, how to extract the optimal Fisher discriminant features efficiently remains unsolved. In this paper, we take advantage of the idea of compressive mapping and isomorphic mapping, and gain a general algorithm for the computation of the optimal discriminant vectors in high-dimensional and singular case. Our algorithm runs in a low dimensional transformed space, and leads to significant computational reduction. Furthermore, a uniform algorithm framework for Fisher discriminant analysis in singular case is developed. Based on this framework, the generalized Foley-Sammon discriminant analysis (FSDA) and Jin-Yang uncorrelated discriminant analysis (JYDA) are presented firstly. Then, a combined Fisher diseriminant analysis (CFDA) is developed, which not only has the advantages of FSDA and JYDA but also overcomes their weakness. The CFDA is tested on the ORL face image database, the classification result is very robust, with a recognition accuracy of 97%. Experimental results demonstrate that CFDA is better than FSDA and JYDA and is superior to Eigenfaces and Fisherfaces as well.

Key words Fisher criterion linear discriminant analysis Foley-Sammon linear discriminant analysis combined linear discriminant analysis high-dimensional and small sample size problem face recognition

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