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FACIAL EXPRESSION RECOGNITION USING FUZZY LAPLACIANFACES

Ruicong Zhi and Qiuqi Ruan

Institute of Information Science
Beijing Jiaotong University
Beijing, 100044, P. R. China
05120370@bjtu.edu.cn; qqruan@center.bjtu.edu.cn

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Abstract. *This paper proposes a novel linear manifold method called Fuzzy Class Preserving Projections for feature extraction. Fuzzy class preserving projections aim to preserve the relationship degree of each sample belonging to given classes. The weight between samples is determined by the fuzzy k-nearest neighbor classifier. The advantage of such assignment is that these membership values act as strength or confidence with which the current sample belongs to a particular class. Furthermore, Fuzzy Laplacianfaces which is the combination of principal component analysis (PCA) and fuzzy class preserving projections (FCPP) are used for facial expression recognition. Experimental results on Cohn-Kanade and JAFFE databases show that Fuzzy Laplacianfaces can distinguish confusing facial expressions efficiently, and it significantly outperforms other conventional methods like Laplacianfaces and Fisherfaces.*
Keywords: Fuzzy class preserving projections, Fuzzy Laplacianfaces, Facial expression recognition, Fuzzy k-nearest neighbor classifier

1. **Introduction.** Facial expression recognition is one of the most important subjects in the fields of human-computer interaction and information processing, which has academic value and potential applications. Until now, facial expression recognition has wide range of applications in telecommunication, law enforcement and psychological research [1, 2, 3]. Generally, an automatic facial expression recognition system consists of three major components: face detection, facial expression representation and facial expression classification [4]. Most research currently concentrates on how to achieve a better facial expression representation and feature extraction. As intrinsic features of the facial expressions are located in high-dimensional space, meaningful low-dimensional structures have to be found by dimensionality reduction.

The most well-known feature extraction techniques including Eigenfaces, Fisherfaces, and Laplacianfaces [5] and all of them, are subspace-based techniques. Given a set of high-dimensional data points, subspace-based techniques aim at discovering the geometric properties of the data space, such as its Euclidean embedding, intrinsic dimensionality, connected components, homology, etc [6]. In this paper, we focus on linear techniques due to the consideration of computational complexity.

Eigenfaces apply the principal components analysis (PCA) to compute the linear projections of greatest variance from the top eigenvectors corresponding to the largest eigenvalues of the data covariance matrix. Fisherfaces use both PCA and Fisher linear discriminant (FLD) for feature extraction. FLD is a supervised learning algorithm which seeks a transformation matrix in such a way that the ratio of the between-class scatter and the within-class scatter is maximized. Studies have shown that subspace-based analysis is an effective approach for facial expression recognition. However, both PCA and FLD