

# Combining Multi-Independent Algorithms for Human Face Recognition

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**Abstract.** During the past 30 years, many different face-recognition techniques have been proposed, motivated by the increased number of real-world applications requiring the recognition of human faces. In this paper, a combination methodology of Discrete Cosine Transform (DCT) and an improved D-LDA and Neural Networks was proposed. After calculating the eigenvectors and a new Fisher's criterion using improved D-LDA algorithm we proposed, the projection vectors are calculated for the training set and then used to train the neural networks for human identity. The experimental results on ORL face database show that this combined method has well performance.

**Keywords:** Face recognition, DCT, D-LDA, BPNNs

## 1 Introduction

In the past decades, many different face-recognition techniques have been proposed, motivated by the increased number of real-world applications requiring the recognition of human faces. PCA algorithm is known as Eigen face method; In PCA method the images are projected onto the facial value so called eigenspace [1] and [2]. PCA approach reduces the dimension of the data by means of basic data compression method [3] and reveals the most effective low dimensional structure of facial patterns [4]. LFA method of recognition is based on the analysis the face in terms of local features e.g. eye, nose etc. by what is referred LFA kernels. Recognition by Neural Network [5] and [6] are based on learning of the faces in an "Example Set" by the machine in the "Training Phase" and carrying out recognition in the "Generalization Phase". Support Vector Machines (SVM) technique is in fact one of the binary classification methods. The support vectors consist of a small subset of training data extracted by the algorithm given in [7]. Face recognition based on template matching represents a face in terms of a template consisting of several enclosing masks the projecting features e.g. the mouth, the eyes and the nose [8]. In [9], a face detection method based on half face-template is discussed.

## 2 Improved D-LDA algorithm for feature extraction in DCT domain

DCT own fast Fourier Transform algorithm (FFT), as great speed advantage than K-L transform. Based on the theory above, we implement the original face image with DCT before the extraction of face feature. As figure 1(b) show us, we only reserve the part of DCT coefficient on the top-left corner to reduce dimensions, it can concentrate the energy and overcome the shortcomings of missing useful information in  $S_w$  null space indirectly when wiping off  $S_b$  null space using LDA at next step.

There is a problem in D-LDA algorithm: its optimization criteria are not directly related to the classification accuracy, as well as traditional LDA algorithm. Because the edge class plays a leading role which decomposes to the characteristic, it leads to dimension reduction matrix emphasizes the class excessively which has been classed well, thereby to make the others classes overlapped. To this problem, we redefine the within-class scatter matrix and the between-class scatter matrix of the sample.

## 3 Face recognition based on neural networks

In this paper, we construct integrated BP neural networks to identify face. The core of integrated networks design is dividing K categories into 2-category problems. This construction can swift one complex problems into several easy questions and the modules in integrated networks are mutual parallel connection and each is in charge of one mode identify. According to this idea, we design a kind of integrated sorter composed by several BP networks. Namely, we integrate K multi-input and single-output BP networks and one BP networks is one sub networks charging one mode class in K categories.

## 4 Conclusion

In this paper, a combination methodology of Discrete Cosine Transform (DCT) and an improved LDA and integrated BPNNs was proposed. The method based on DCT can compress the information of original signal efficiently; Furthermore, the improved D-LDA algorithm we proposed can withhold useful information and restrain the effect of edge class preferable through redefining the within-class scatter matrix and between-class scatter matrix, enhance the recognition rate by reducing dimension, and it can solve the small sample size problem without losing useful information. After that, the projection vectors are calculated for the training set and then used to train the neural networks for human identity.

We performed our experiments with the standard ORL face database. Experimentally, we find that the methodology we proposed which based on combination multi-algorithm provide better results than the corresponding individual algorithms.

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## Reference

1. Turk, M. and A. Pentland.: Eigenfaces for Recognition, *Journal of Cognitive Neuroscience*, pp. 71--86 (1991)
2. Tat-Jun Chin and David Suter.: A Study of the Eigenface Approach for Face Recognition, In: Technical Report of Monash University, Dept.Elect & Comp.Sys Eng (MECSE 2004) Australia, pp.1--18 (2004)
3. D. Blackburn, M. Bone, and P. Phillips.: Facial Recognition Vendor Test 2000: Evaluation Report, National Institute of Science and Technology, Gaithersburg, USA (2000)
4. P. J. Phillips, H. Moon, S.Rizvi and P. Rauss.: FERET Evaluation Methodology for Face Recognition Algorithms, *IEEE transaction on pattern analysis and machine intelligence (PAMI 2000)*, Los Alamitos, USA, pp.1090--1103 (2000)
5. D. Bryliuk and V. Starovoitov.: Access Control by Face Recognition using Neural Networks and Negative Examples, In: 2nd International Conference on Artificial Intelligence, Crimea, Ukraine, pp. 428--436 (2002)
6. S. A. Nazeer, N. Omar, M. Khalid.: Face Recognition System using Artificial Neural Networks Approach, In.: *IEEE International Conference on Signal Processing, Communications and Networking*, pp.420--425 (2007)
7. Huang, X. Shao, and H. Wechsler.: Face Pose Discrimination Using Support Vector Machines, Technical report of George Mason University and University of Minnesota, Minneapolis Minnesota, United States (1998)
8. R. Brunelli and T. Poggio.: Face Recognition: Features versus Templates, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 15, no.10, pp.1042--1052 (1993)
9. Wei Chen, Tongfeng Sun, Xiaodong Yang, and Li Wang.: Face detection based on half face template, In.: *Proc. of the IEEE Conference on Electronic Measurement and Instrumentation*, pp. 54--58 (2009)