Chapter 30
Combining Block DCV and Support Vector Machine for Ear Recognition

Zhao Hailong
Beijing University of Civil Engineering and Architecture, China

Yi Junyan
Beijing University of Civil Engineering and Architecture, China

ABSTRACT

In recent years, automatic ear recognition has become a popular research. Effective feature extraction is one of the most important steps in Content-based ear image retrieval applications. In this paper, the authors proposed a new vectors construction method for ear retrieval based on Block Discriminative Common Vector. According to this method, the ear image is divided into 16 blocks firstly and the features are extracted by applying DCV to the sub-images. Furthermore, Support Vector Machine is used as classifier to make decision. The experimental results show that the proposed method performs better than classical PCA+LDA, so it is an effective human ear recognition method.

1. INTRODUCTION

With the development of our society, the demands for identify validation has been increasing rapidly. So biometrics is receiving more and more attention in recent years and it plays an important role in almost every aspect of new security measures - from control access point to terrorist identification. Ear has certain advantages over other biometrics because of is desirable such as universality, uniqueness and permanence (Iannarelli, 1989; Chang, Bowyer, Sarkar & Victor, 2003).

In recent years, discriminant subspace analysis has been extensively studied in computer vision and pattern recognition. One popular method is Linear Discriminant Analysis, also known as the Fisher Linear Discriminant (FLD). It tries to find an optimal linear transformation which maximizes the between-class scatter and minimizes the within-class scatter3,4. To be more specific, in terms of the between-class scatter matrix S_B and the within-class scatter matrix S_W, the Fisher's Criterion can be written as

$$J_F(W_{opt}) = \arg\max_W \frac{\left|W^T S_B W\right|}{\left|W^T S_W W\right|} \tag{1}$$

By maximizing the criterion J_F, Fisher Linear Discriminant finds the subspaces in which the classes are most linearly separable. The solution that maximizes J_F is a set of the eigenvectors $\{\phi_i\}$ which must satisfy

$$S_B \phi = \lambda S_W \phi \tag{2}$$

This is called the generalized eigenvalue problem. The discriminant subspace is spanned by the generalized eigenvectors. The discriminability of each eigenvector is measured by the corresponding generalized eigenvalue, i.e., the most discriminant subspace corresponds to the maximal generalized eigenvalue. The generalized eigenvalue problem can be solved by matrix inversion and eigentransform, i.e., applying the eigentransform on $S_W^{-1} S_B$. Unfortunately, for many applications with high dimensional data and few training samples, such as ear recognition, the scatter matrix S_W is singular because generally the dimension of sample data is greater than the number of samples. This is known as the undersampled or small sample size problem (Sergios Theodoridis & Konstantinos, Koutroumbas, 2008; Friedman, 1989; Fukunaga, 1990).

In the last decade many methods have been proposed to solve this problem (Belhumeur, Hespanha, & Kriegman, 1997; Liu, & Wechsler, 1998; Yu & Yang, 2001; Chen, Liao, Lin, Ko & Yu, 2000; Huang, Liu, Lu & Ma, 2002). These methods have their problem respectively, which either remove the discriminant information useful to classification or has an expensive computing cost. Cevikalp11 et al. put forward a method called Discriminative Common Vector (DCV) and it has solved the above problems successfully. However, when the authors directly apply DCV on sample images with high-dimensions, the computational expense of training is still relatively large.

In this paper, a new method is proposed in this paper that every human ear is divided into 16 blocks firstly and the features are extracted by applying DCV to the sub-images. The remainder of the paper is organized as follows: In Section 2, Block method and Discriminative Common Vector algorithm are introduced. In Section 3, the Support Vector Machine algorithm is stated. In Section 4, the authors describe the data sets and experimental results for the USTB (77) and the USTB (79) ear databases. At the same time, the experiment steps are introduced and the experimental results are given. Finally, the authors formulate our conclusions in section 5.

2. BLOCK DISCRIMINATIVE COMMON VECTOR ALGORITHM

The idea of common vectors was originally introduced for isolated word recognition problems in the case where the number of samples in each class was less than or equal to the dimensionality of the sample space (Gulmezoglu, Dzhafarov, Keskin, & Barkana,1 999; Gulmezoglu, Dzhafarov,& Barkana 2001). These approaches extract the common properties of classes in the training set by eliminating the differences of the samples in each class. A common vector for each individual class is obtained by removing all the features that are in the direction of the eigenvectors corresponding to the nonzero eigen-

8 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/combining-block-dcv-and-support-vector-machine-for-ear-recognition/196978

Related Content

Image Representation Using a Sparsely Sampled Codebook for Super-Resolution
Hwa-Young Kim, Rae-Hong Parkand Ji-Eun Lee (2014). *Research Developments in Computer Vision and Image Processing: Methodologies and Applications (pp. 1-14).*
www.irma-international.org/chapter/image-representation-using-a-sparsely-sampled-codebook-for-super-resolution/79717

An Efficient Generalized Error Concealment in Video Codec
Ansari Vaqar Ahmedand Uday Pandit Khot (2020). *International Journal of Computer Vision and Image Processing (pp. 1-28).*
www.irma-international.org/article/an-efficient-generalized-error-concealment-in-video-codec/264218

Healthcare Cloud Services in Image Processing
Vivek Veeraiah, Dolly John Shiju, J.V.N. Ramesh, Ganesh Kumar R., Sabyasachi Pramanik, Digvijay Pandeyand Ankur Gupta (2023). *Handbook of Research on Thrust Technologies' Effect on Image Processing (pp. 332-347).*
www.irma-international.org/chapter/healthcare-cloud-services-in-image-processing/328041

Image Registration Techniques and Frameworks: A Review
Sayan Chakraborty, Prasenjit Kumar Patra, Prasenjit Maji, Amira S. Ashourand Nilanjan Dey (2017). *Applied Video Processing in Surveillance and Monitoring Systems (pp. 102-114).*
www.irma-international.org/chapter/image-registration-techniques-and-frameworks/168902

Visual Control of an Autonomous Indoor Robotic Blimp
L. M. Alkurdiand R. B. Fisher (2013). *Robotic Vision: Technologies for Machine Learning and Vision Applications (pp. 352-370).*
www.irma-international.org/chapter/visual-control-autonomous-indoor-robotic/73199