PCA VERSUS LDA IN IMPLEMENTING OF NEURAL CLASSIFIERS FOR FACE RECOGNITION

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Abstract: This paper proposes to better determine people’s face recognition methods using images. Using the selection of features principal component analysis and linear discriminant analysis I conducted experiments by implementing two methods called Self Organizing Map classification (SOM and CSOM 1). I tried to get the best recognition rates for different color components, followed by selection of features concatenation. Applications training consisted of images from a database of its own. Analysis was performed by changing a number of 80 to 360 neurons trained with a pitch of 40 to obtain a recognition rate of 100%. Finally I concluded for the best versions of selections for features that the two methods give proposing future research.

Keywords: principal component analysis, linear discriminant analysis, Self Organizing Map, number of neurons, the recognition rate.

1. METHODS OF EXTRACTION AND SELECTION OF FEATURES FROM IMAGES

Extraction and selection characteristics for faces of people in an image are two important stages on the success and performance of the recognition and face detection (fig. 1).

![Diagram](image)

Fig. 1. Extraction and selection of features in an image

A correct implementation of the recognition regions obtained from image segmentation process requires input video representation in a stable form of data analyzed by eliminating redundant information and retaining information for face recognition.

The process of obtaining such a representation of the region of interest is known as the step of description / retrieval features.

Description is directly related to the chosen data structure for representation, against which there is a strong dependence on the developed application.

The possibilities for description of a region is diversified depending on the methods implemented for selection of features:

• characterization of the region contour shape (contour descriptors);
• characterize the region based on its interior (descriptors regional or time);
• topological description of the region of interest (textures);
• morphological description of the region of interest (morphological descriptors).

Choosing a proper description is essential for the success of the shape recognition process. Also, a fundamental principle which oversees construction shape descriptors is their invariance principle to various types of linear or nonlinear transformations applied form of interest. The desired invariance of the set of descriptors used at the starting point, scaling, translation, rotation and reflection.
Practical experience shows that the most important aspect for the recognition of forms is the selection characteristics / properties or descriptors used.

Selection is a process characteristic features data compression and can be equated with a linear or nonlinear transformation of the initial space of n-dimensional observations assumed in a space with fewer dimensions.

The transformation performed conservation information and enables the development of algorithms in real time with efficient algorithms in terms of computation time and memory resources required only small spaces.

If a single class of forms, selection of characteristics is considered optimal if the dimensionality reduction achieved with the original information preservation majority.

If there are several classes of shapes, selection efficiency characteristics is given in particular the possibility of separability of classes, which depends mostly on the distribution of classes and selected classifier.

As a reference in this work we have demonstrated in various [1-7], the performance of classifiers, and as a measure of the effectiveness of selected features can be considered the possibility of their error.

Note that most transformations used to select characteristics are linear but non-linear transformations can be used even if they are difficult to implement.

They can provide a higher efficiency expressing the dependence of the real forms observed raw data extracted and selected characteristics of those forms.

2. METHODS FOR THE SELECTION OF CHARACTERISTICS

Size space features large extent influence the efficiency and performance of classification algorithms. Thus, a number of classification algorithms effective in small spaces become impractical in larger spaces.

Therefore we sought to implement changes to prioritize the importance of characteristics and allow transformed space thus reducing its size by removing the least significant data, while retaining the essential information for classification.

In this paper we experienced select those features that contain the greatest amount of information on that form.

We presented the results of selection methods that provide an application characteristics in the area of military interest through proven performance on recognition rate.

2.1. Principal components analysis (PCA).

Principal components analysis (PCA Principal Component Analysis) is a standard method of data analysis that enables the detection of the most prominent trends in a set of data.

PCA reduces the number of variables that the size of a data set.

![Fig. 2. Version for representation using PCA projection](image)

The picture shows a network in a two-dimensional subspace. PCA is used to view the data by reducing the dimensionality of the data.

The three variables are reduced to a smaller number, two new variables called principal components (PC). Using PCA, we can identify two-dimensional plane which best describes the varied data.

The first component, PC 1 is the direction with the largest variance of the data. PC Division 2 is the largest variance that remained after the first orthogonal component. The representation allows to obtain the required number of components that covers a space and the desired amount of variance.
LDA tries to find the best projection direction vectors belonging to different classes drive are best separated.

![Fig. 3. Variant of projection for representation using LDA](image)

Presentation of the algorithm and the applications that have been described in [10]. There were also tested for applications of LDA transform two-dimensional vector and pixel classification of soil and vegetation images using LDA transformed.

### 3. EXPERIMENTAL RESULTS

Through various experiments we tried validating theoretical interest arising from the comparative study of methods for selecting features using PCA and LDA methods for classification as SOM and CSOM1 80-400 neurons in neural networks trained with a step 40.

The database contains 556 personal photos of 46 subjects who were asked to stimulate different physiognomic states, against a pale and normal lighting. It was shown in [6].

The main criterion for validating the importance of selection methods analyzed is the performances in the subsequent classification / recognition and entry forms as classifier we used a trained neural network.

Experiments to determine the most effective method of selection.

The experiment consisted in selecting 4 of the 46 subjects of the database in 7 test images / 7 training images.
The 7 images drive and 7 test images were chosen at random, and are analyzed in terms of the form RGB color spaces, C1, C1C2 and C1C2C3.

The original images were reduced in size by using the Paint for 90/120 pixels.

Table 1. Results using the database 7i / 7t, the recognition rate for PCA method C1C2C3 components [%] feature selection process followed by concatenation

<table>
<thead>
<tr>
<th>Method</th>
<th>Features</th>
<th>Number of features</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOM</td>
<td>PCA</td>
<td>40 80 120 160 200</td>
</tr>
<tr>
<td></td>
<td>LDA</td>
<td>90.9 93.5 95.1 97.9</td>
</tr>
<tr>
<td>CSOM</td>
<td>PCA</td>
<td>48.5 52.3 57.3 61.7</td>
</tr>
<tr>
<td></td>
<td>LDA</td>
<td>68.6 74.2 79.8 85.4</td>
</tr>
</tbody>
</table>

Table 2. Results using the database 7i / 7t, the recognition rate for PCA method C1C2 components [%] feature selection process followed by concatenation

<table>
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</tr>
<tr>
<td></td>
<td>LDA</td>
<td>68.6 74.2 79.8 85.4</td>
</tr>
</tbody>
</table>

Table 3. Results using the database 7i / 7t, the recognition rate for PCA method for component C1 [%] feature selection process followed by concatenation

<table>
<thead>
<tr>
<th>Method</th>
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</thead>
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Considering the fact that a large percentage of an image in the database is the background, I applied a face detection algorithm discovered by prof. Neagoe presented in reference [9], implemented in Matlab.

Methods for selecting features that we used PCA and LDA are and classifiers that I used CSOM and SOM. They are presented in the paper [9,11,13,14].

Concurrent Self Organizing Maps CSOM method was discovered by Neagoe and Popot and presented in [13].

For the selection of features with PCA we retained 100 features for each color, and then the resulting concatenated vectors of the three colors 100 features 3x = 300 features being used in classification.

LDA for the selection of characteristics we used the same conditions as in [9].

We imposed the following parameters CSOM networks and SOM: stop condition after 400 epochs of training; neighborhood radius decreases by 1 at every age; for the first 200 periods, and for the next 200 era.

The results obtained using images resulting from the scan, which have been reduced in size 90/120 interpolated pixels.
The same conditions were used as in the previous experiment to give the following results:

Table 6. Results using the database 46i / 1t, the recognition rate for RGB component PCA method [%], using the classifier CSOM 1

<table>
<thead>
<tr>
<th>Method</th>
<th>Features</th>
<th>Number of neurons</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSOM/1</td>
<td>PCA</td>
<td>48.73</td>
</tr>
<tr>
<td></td>
<td>LDA</td>
<td>78.39</td>
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<td>LDA</td>
<td>78.39</td>
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Table 7. Results from the database 46 and / 1t, the recognition rate for PCA method C1C2C3 components [%] feature selection process followed by concatenation

<table>
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4. CONCLUSIONS

The final results, involving the entire database showed that the best solution is to implement color components C1C2C3 [%] selection process followed by concatenation of features offered by the SOM method of classification and feature selection using LDA.

If CSOM1 using the same selection method features a 100% recognition rate results from the training of 360 neurons. Regarding the recognition rate for RGB component PCA method [%], using classifier Csömőri 1 all features using LDA selection proved with the best rate of 84.88% recognition for 400 neurons involved. In this case the selection of features using PCA smaller achieve results that a recognition rate of only 73.14% from 360 neurons involved. Looking processing time this is tens of minutes in both cases.
Future opportunities for the development of research is emerging in the real-time image processing. Therefore I will follow different implementations other than Matlab, which carries a large number of computing that require processing time and high computing power.

We will continue to implement the application using Python modules offered by Accord.Net. The framework provided by OpenCV. Experiments show actual processing time of about 400 ms. using this method, compared to tens of minutes offered by the experimental using Matlab.

Relevant is that the military applications of detection and/or individuals face recognition that local Trackbacks detection, suspicious persons or prohibited in various sports events, the data recorded at the border of the fugitives, etc., are needed both to obtain a 100% recognition rate and the processing of a real-time/signaling themselves- all in order not to lose the operating time.

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BIBLIOGRAPHY