LITERATURE REVIEW ON "FACE RECOGNITION IN NAVIGATING HUMANOIDS USING CNN & LDA

Team: Karthik Sajjan (19BCS049), Karusala Deepak Chowdary (19BCS050), Kuppa Venkata Krishna Paanchajanya (19BCS063)

Reviewed articles on: LDA

LDA (Linear Discriminant Analysis)

Linear Discriminant Analysis is an appearance based technique used for dimensionality reduction and recorded a great performance in face recognition. It provides us with a small set of features that carry the most relevant information for classification purposes.

LDA is a statistical approach for classifying samples of unknown classes based on training samples with known classes. This technique aims to maximum between-class (across users) variance and minimum within class (within user) variance. In these techniques a block represents a class and there are a large variations between blocks but little variations within classes. It searches for those vectors in underlying space that best discriminate among classes (rather than those that best describe the data). More formally given a number of independent features relative to which the data is described. LDA creates a linear combination of these which yields the largest mean difference between desire classes. SB (between class scatter) represents the scatter of features around the overall mean for all face classes and SW(within class scatter) represents the scatter of features around the mean of each face class.

Mathematically two measures are defined:

- One is called within-class scatter matrix which is given by-

$$S_w = \sum_{j=1}^{c} \sum_{i=1}^{\bar{N}_j} (X_i^j - \mu_j)\,(X_i^j - \mu_j)^T$$

- Other is called between class scatter matrix

$$S_b = \sum_{j=1}^{c} (\mu_j - \mu)(\mu_j - \mu)^T$$ [1]

Linear Discriminant analysis explicitly attempts to model the difference between the classes of data. LDA is a powerful face recognition technique that overcomes the limitation of Principal component analysis technique by applying the linear discriminant criterion. Linear discriminant group images of the same class and separates images of different classes of the images. The major drawback of applying LDA is that it may encounter the Small Sample Size problem (SSS). When the small sample size problem occurs, the within-class scatter matrix becomes singular. Since the within-class scatter of all the samples is zero in the null space of Sw, the projection vector that can satisfy the objective of an LDA process is the one that can maximize the between-class scatter[2].

Conclusion

LDA finds the vectors in the underlying space that best discriminate among classes. For all samples of all classes the between-class scatter matrix SB and the within-class scatter matrix SW are defined. The goal is to maximize SB while minimizing SW. It classifies the data. This criterion tries to maximize the ratio of the determinant of the between-class scatter matrix of the projected samples to the determinant of the within class scatter matrix of the projected samples. Linear discriminant group images of the same class and separates images of different classes of the images.

Using LDA, the face recognition systems reach the accuracy of about 89.9%[3].

References

[1] Aruni Singh, Sanjay Kumar Singh, Shrikant Tiwar "Comparison of face Recognition Algorithms on Dummy Faces" The International Journal of Multimedia & Its Applications (IJMA) Vol.4, pp 121-135, 2012.

[2] Suman Kumar Bhattacharyya, Kumar Rahul, "Face Recognition by Linear Discriminant Analysis," unpublished.

[3] Zhao, W., Chellappa, R., Krishnaswamy, A.: Discriminant Analysis of Principal Components for Face Recognition, Proc. of the 3rd IEEE International Conference on Face and Gesture Recognition, FG'98, (1998) 336