FACE DETECTION USING MATLAB

T.Sudheer Kumar[#1], N.Vishwanath [*2] K.Karthik[*3]

[#,*]ECE Department,
St.Martins.Engineering College,
Dhulapally, Secunderabad, Telangana

***Abstract*: Object detection and tracking are important in many computer vision applications, including activity recognition, automotive safety and surveillance. Presented here is an face detection using MATLAB system that can detect not only a human face but also eyes and upper body. Face detection is an easy and simple task for humans, but not so for computers. It has been regarded as the most complex and challenging problem in the field of computer vision due to large intra-class variations caused by the changes in facial appearance, lighting and expression. Such variations result in the face distribution to be highly nonlinear and complex in any space that is linear to the original image space. Face detection is the process of identifying one or more human faces in images or videos. It plays an important part in many biometric, security and surveillance systems, as well as image and video indexing systems.**

***Index Terms*: Intra-class variations, Object detection, activity recognition, video Indexing systems, Face detection.**

I. INTRODUCTION

Face detection involves separating image windows into two classes; one containing faces (turning the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin colour and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background [1]. The face detection task can be broken down into two steps. The first step is a classification task that takes some arbitrary image as input and outputs a binary value of yes or no, indicating whether there are any faces present in the image. The second step is the face localization task that aims to take an image as input and output the location of any face or faces within that image as some bounding box with (x, y, width, height)[10].

The face detection system can be divided into the following steps:-

Pre-processing: To reduce the variability in the faces, the images are processed before they are fed in to the network. Al positive examples that is the face images are obtained by cropping images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms [12].

Classification: Neural networks are implemented to classify the images as faces or non faces by training on these examples. We use both our implementation of the neural network and the Matlab neural network toolbox for this task. Different network configurations are experimented with to optimize the results [5].

Localization: The trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various Feature of Face on which the work has done on:- Position Scale Orientation Illumination

II. FACE DETECTION ALGORITHM AND ITS METHODS

Face-detection algorithms focus on the detection of frontal human faces. It is analogous to image detection in which the image of a person is matched bit by bit. Image matches with the image stores in database. Any facial feature changes in the database will invalidate the matching process [11]. A reliable face-detection approach based on the genetic algorithm and the Eigen-face technique Firstly, the possible human eye regions are detected by testing all the valley regions in the gray-level image. Then the genetic algorithm is used to generate all the possible face regions which include the eyebrows, the iris, the nostril and the mouth corners. Each possible face candidate is normalized to reduce both the lighting effect, which is caused by uneven illumination; and the shirring effect, which is due to head movement. The fitness value of each candidate is measured based on its projection on the Eigen-faces [2]. After a number of iterations, all the face candidates with a high fitness value are selected for further verification. At this stage, the face symmetry is measured and the existence of the different facial features is verified for each face candidate.

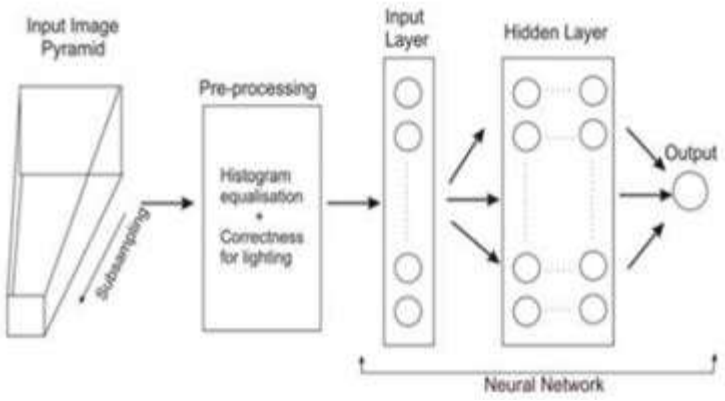

Fig: 2.1.Face Detection Algorithm

Face detection is a computer technology that determines the location and size of human face in arbitrary (digital) image. The facial features are detected and any other objects like trees, buildings and bodies etc. are ignored from the digital image. It can be regarded as a specific case of object-class detection, where the task is finding the location and sizes of all objects in an image that belong to a given class [4]. Face detection, can be regarded as a more general case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). Basically there are two types of approaches to detect facial part in the given image i.e. feature base and image base approach. Feature base approach tries to extract features of the image and match it against the knowledge of the face features. While image base approach tries to get best match between training and testing images [6].

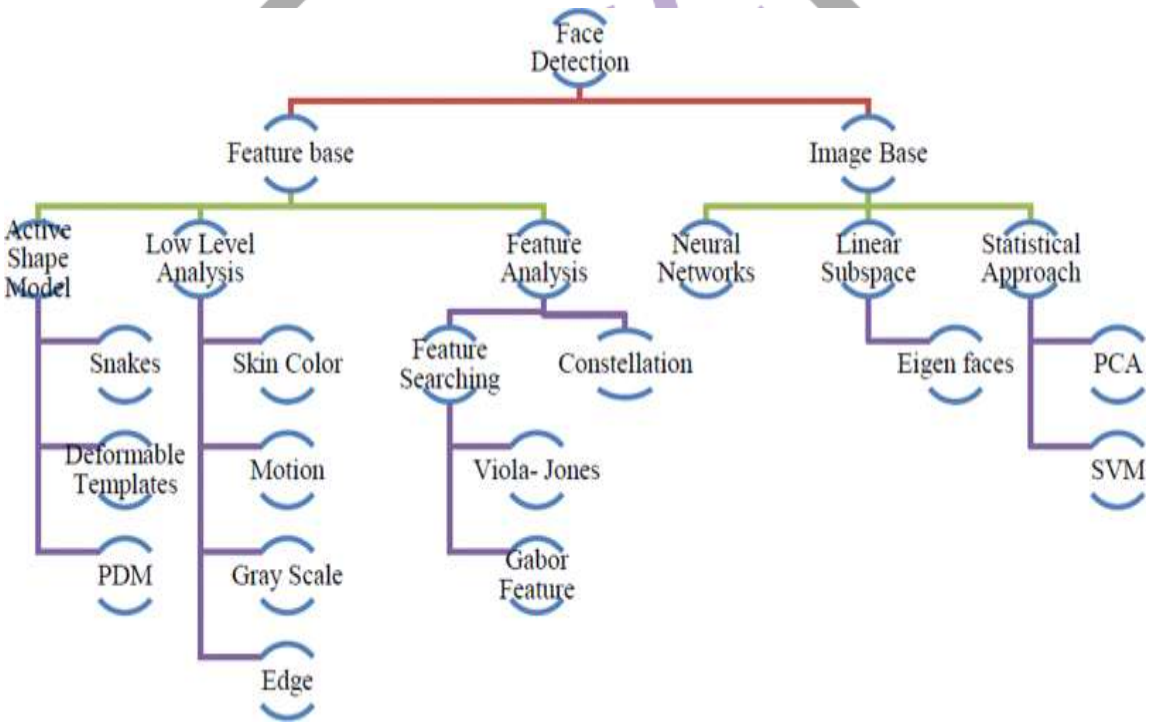

Fig .22.Detection methods

III. **FACE RECOGNITION**

Over the last few decades many techniques have been proposed for face recognition. Many of the techniques proposed during the early stages of computer vision cannot be considered successful, but almost all of the recent approaches to the face recognition problem have been creditable. According to the research by Brunelli and Poggio all approaches to human face recognition can be divided into two strategies:

(1) Geometrical features and
(2) Template matching.

FACE RECOGNITION USING GEOMETRICALFEATURES

This technique involves computation of a set of geometrical features such as nose width and length, mouth position and chin shape, etc. from the picture of the face we want to recognize. This set of features is then matched with the features of known individuals. A suitable metric such as Euclidean distance (finding the closest vector) can be used to find the closest match. Most pioneering work in face recognition was done using geometric features although Craw did relatively recent work in this area [7].

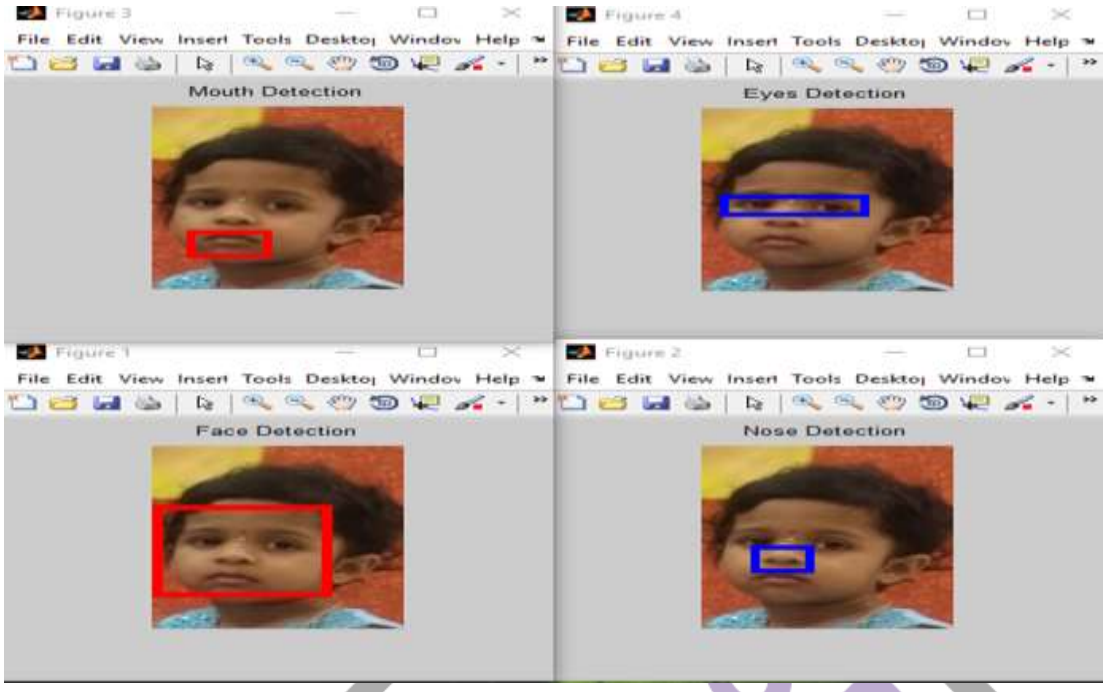

Fig: 3.1 Geometrical features (white) which could be used for face recognition

The advantage of using geometrical features as a basis for face recognition is that recognition is possible even at very low resolutions and with noisy images (images with many disorderly pixel intensities). Although the face cannot be viewed in detail its overall geometrical configuration can be extracted for face recognition [8]. The technique's main disadvantage is that automated extraction of the facial geometrical features is very hard. Automated geometrical feature extraction based recognition is also very sensitive to the scaling and rotation of a face in the image plane this is apparent when we examine Kanade's results where he reported a recognition rate of between 45-75 % with a database of only 20 people [10].

FACE RECOGNITION USING TEMPLATE MATCHING

This is similar the template matching technique used in face detection, except here we are not trying to classify an image as a 'face' or 'non-face' but are trying to recognize a face.

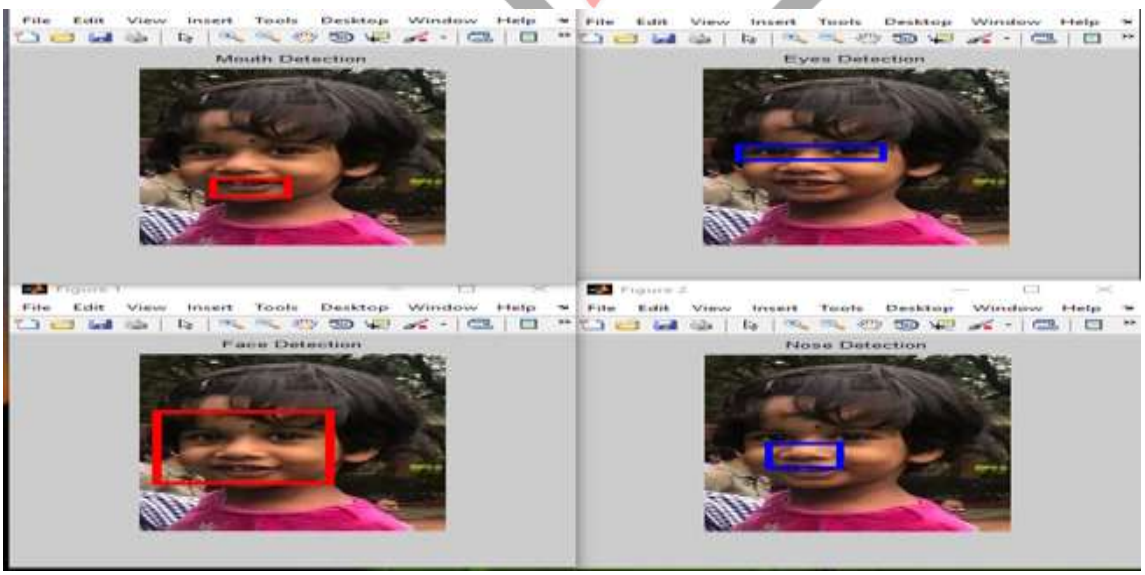

Figure: 3.2. Face recognition using template matching

Whole face, eyes, nose and mouth regions which could be used in a template matching strategy. The basis of the template matching strategy is to extract whole facial regions (matrix of pixels) and compare these with the stored images of known individuals. Once again Euclidean distance can be used to find the closest match. The simple technique of comparing grey-scale intensity values for face recognition was used by Baron. However there are far more sophisticated methods of template matching for face recognition [9]. These involve extensive pre- processing and transformation of the extracted grey-level intensity values.

IV.RESULTS AND DISCUSSIONS

The problem of face recognition is all about face detection. This is a fact that seems quite bizarre to new researchers in this area. However, before face recognition is possible, one must be able to reliably find a face and its landmarks. This is essentially a segmentation problem and in practical systems, most of the effort goes into solving this task. In fact the actual recognition based on features extracted from these facial landmarks is only a minor last step.

FACE DETECTION IN IMAGES

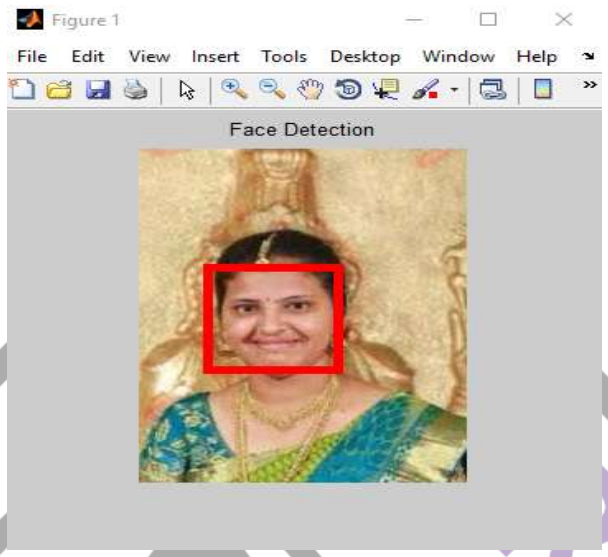

Fig 4.1. Successful face detection in an image with a frontal view of a human face

Most face detection systems attempt to extract a fraction of the whole face, thereby eliminating most of the background and other areas of an individual's head such as hair that are not necessary for the face recognition task. With static images, this is often unfortunately, with static images there is a very large search space of possible locations of a face in an image there is another technique for determining whether there is a face inside the face detection system's window - using Template Matching. The difference between a fixed target pattern (face) and the window is computed and threshold. If the window contains a pattern which is close to the target pattern (face) then the window is judged as containing a face

REAL-TIME FACE DETECTION

Real-time face detection involves detection of a face from a series of frames from a video- capturing device. While the hardware requirements for such a system are far more stringent, from a computer vision stand point, real-time face detection is actually a far simpler process than detecting face in a static image. This is because unlike most of our surrounding environment, people are continually moving. We walk around, blink, fidget, wave our hands about, etc.

Fig.4.2: Frame 1fromcamera

Fig.4.3: Frame 2 from camera

Fig.4.4: Spatio-Temporally filtered image

Since in real-time face detection, the system is presented with a series of frames in which to detect a face, by using spatio temporal filtering (finding the difference between subsequent frames), the area of the frame that has changed can be identified and the individual detected

PROCESS FLOW

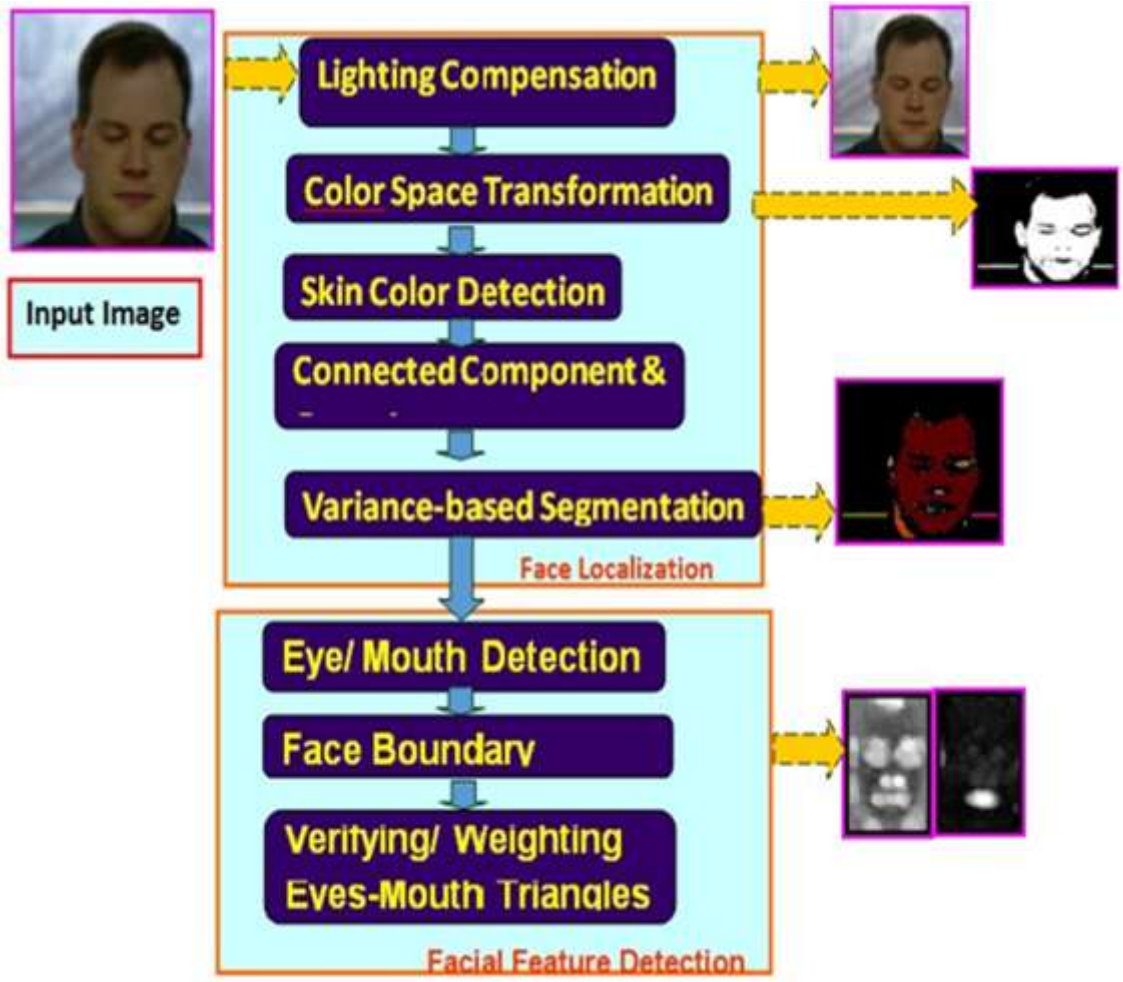

Fig.4.5: Face detection process flow

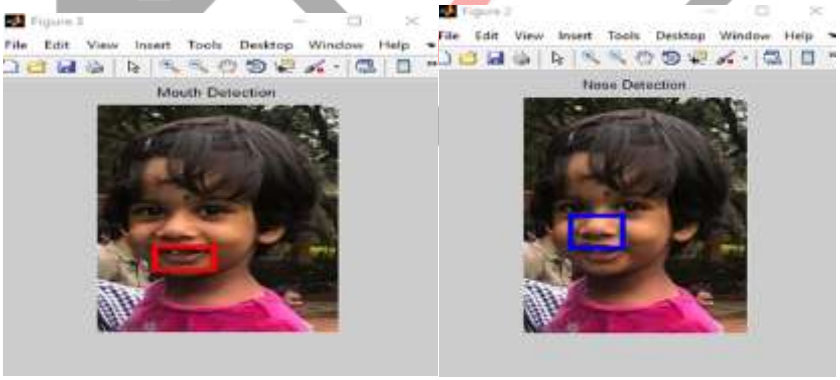

Fig.4.6.Mouth and Nose Detection

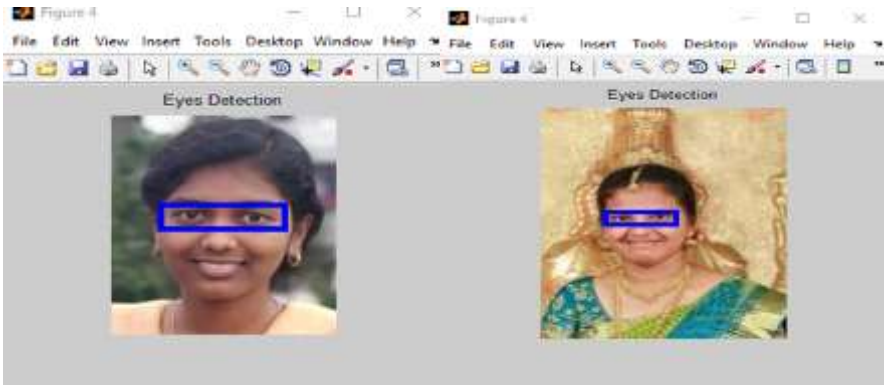

Fig.4.7: Eye detection

V. CONCLUSION

The computational models, which were implemented in this paper, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The fully automated face detection and recognition system was not robust enough to achieve high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale rotation or shift errors of the segmented face image. The implemented fully automated face detection and recognition system (with an eye detection system) could be used for simple surveillance applications such as ATM user security, while the implemented manual face detection and automated recognition system is ideal of mug shot matching

REFERENCES

[1] Adelson, E. H., and Bergen, J. R. (1986) The Extraction of Spatio-Temporal Energy in Human and Machine Vision, Proceedings of Workshop on Motion: Representation and Analysis (pp. 151-155) Charleston, SC; May7-9
[2] AAFPRS(1997). A newsletter from the American Academy of Facial Plastic and Reconstructive Surgery. Third Quarter 1997, Vol. 11, No. 3. Page3.
[3] Baron, R. J. (1981). Mechanisms of human facial recognition. International Journal of Man Machine Studies,15:137-178
[4] Beymer, D. and Poggio, T. (1995) Face Recognition From One Example View, A.I. Memo No. 1536, C.B.C.L. Paper No. 121.MIT
[5] Bichsel,M.(1991). Strategies of Robust Objects Recognition for Automatic Identification of Human Faces.
[6] Brunelli, R. and Poggio, T. (1993), Face Recognition: Features versus Templates. IEEE Transactions on Pattern Analysis and Machine Intelligence,15(10):1042-1052
[7] Craw, I., Ellis, H., and Lishman, J.R. (1987). Automatic extraction of face features. Pattern Recognition Letters, 5:183-187, February.
[8] Deffenbacher K.A., Johanson J., and O'Toole A.J. (1998) Facial ageing, attractiveness, and distinctiveness. Perception.27(10):1233-1243
[9] Gauthier, I., Behrmann, M. and Tarr, M. (1999). Can face recognition really be dissociated from object recognition? Journal of Cognitive Neuroscience, impress.
[10] Goldstein, A.J., Harmon, L.D., and Lesk, A.B. (1971). Identification of human faces. In Proc. IEEE, Vol. 59, page748
[11] Hadamard, J. (1923) Lectures on the Cauchy Problem in Linear Partial Differential Equations , Yale University Press
[12] Johnson, R.A., and Wichern, D.W. (1992) Applied Multivariate Statistical Analysis. Prentice Hall.p356-395

.