

Mathematical Techniques for Face Signature

In this section present a high-level view of various mathematical principles and techniques are used in *face recognition* research. Though these topics are not in the scope of this course, we present at a high-level for a high level understanding.

Processing the pixel matrix of an image, extracting the features and creating a vector has been studied for a long time by mathematicians. The following work is a reference article to have a high-level understanding of various approaches.

*Mejda Chihaumi, Akram Elkefi, Wajdi Bellil and Ben Amar, University of Sfax, **A survey of 2D Face Recognition Techniques**, Computers, 2016,5,21 (28 pages).*

This paper presents a detailed survey of well-known methods and principles. They list out three categories of work on Face recognition.

1. Global Face approach
2. Local features approach
3. Hybrid approach

Global Face approach

In global face approach, researchers have worked on linear and non-linear techniques. The following are Linear techniques:

- Eigen vectors and Eigen Faces
- Principal Component Analysis (PCA)
- Independent Component Analysis (ICA)
- Multidimensional Scaling (MDS)
- Non-negative Matrix Factorization (NMF)
- Liner Discriminant Analysis (LDA)
- Gabor Wavelets

Researchers have also used the following non-linear techniques for Global Face Recognition approach.

- Kernel Functions
- Support Vector Machines (SVM)

- Nearest Manifold Approach

Local Feature Approaches

Local approaches study only same local features of the face such as mouth, eyes etc. Local methods are also called *Feature Based Methods*. There are two categories of research in this approach.

1. Interest Point based
2. Local Appearance based

In the interest point based approach we first detect the point of interest and then extract features around the point.

In local-appearance based methods, the face is divided into smaller regions or patches. From each patch, the local features are extracted.

Hybrid Approaches

To make the algorithm more efficient people have tried hybrid approaches combining some prominent features of global face and some local ones.

Figure – gives a high-level view of all the key methods.

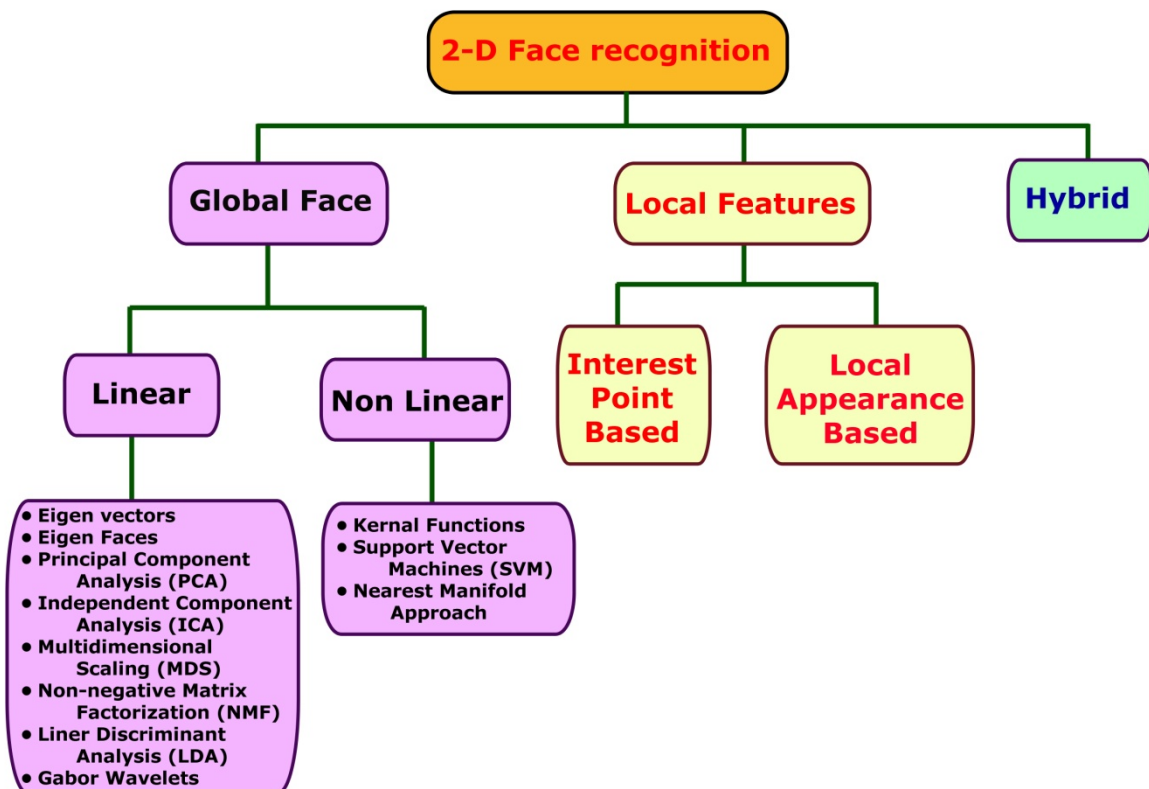


Figure 2.5 2D Face Recognition Algorithms

