Face Recognition Using Active Appearance Models

(Edwards et al, 1998)

CS395T Object Recognition

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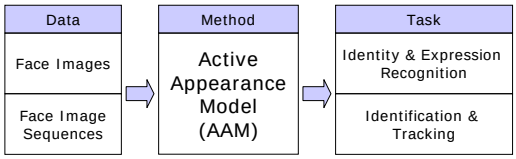
Overview

- New framework for interpretation of face images & image sequences using **Active Appearance Model (AAM)**



Objective

- To develop ***full***, ***photo-realistic model-based*** approach to face recognition
  - ***model-based***: formulating a model to interpret face images and representing them by a set of parameters
  - ***full***: using all information given in the image
  - ***photo-realistic***: able to match directly between the image and model-synthesized example

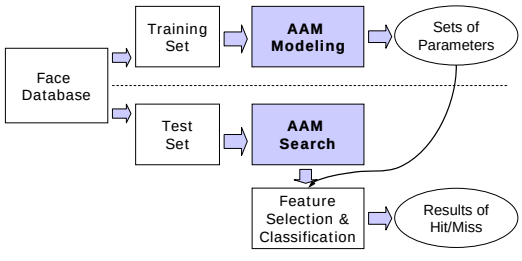
Background

- Eigenface (Turk & Pentland, 1991)
  - Utilizing only appearance information of a face
  - Not robust to expression, pose variations
- Ezzat & Poggio Method (1996)
  - Synthesizing new views of a face from a set of example views
  - Not able to generalize to unseen images
- Active Shape Model (ASM) (Cootes *et al*)
  - Using shape & local appearance information
  - Still not using full information given

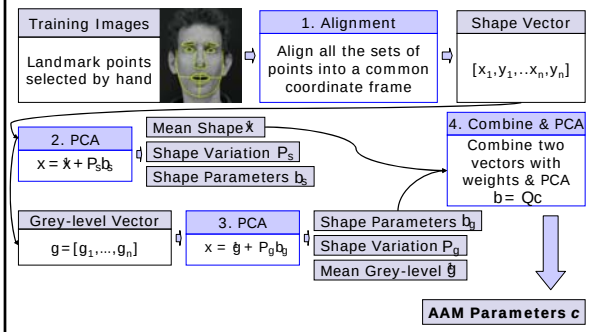
Problem Statement

- Apply developed approach to face images and image sequences, and show that:
  - **Images**: Good recognition performance for personal identification and expression recognition
  - **Image Sequences**: Stable estimate of personal identification

Overall Diagram



AAM Modeling

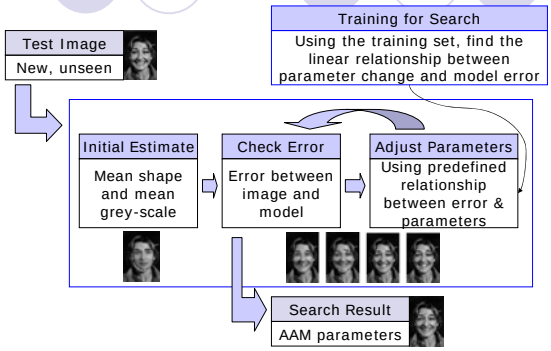


AAM Search

- Task: Find a set of **AAM parameters** that **best matches** a new image based on the AAM model generated by the training set
- **Optimization Problem**
  - Same for any new images: global solution
  - How to solve?

1. Find the relationship between image error and parameter changes
2. Using the relationship, adjust parameters to reduce the error until it converges

AAM Search



Feature Selection

- Linear Discriminant Analysis (LDA)
  - Objective
    - Find the most discriminative feature (ID vs non-ID)
  - Assumption
    - Within-class variation is similar for each person
    - Covariance matrix provides good overall estimate
  - Task
    - Apply LDA to sets of parameters from training data
  - Result
    - Discriminant parameters

Experiment

- Database
  - 400 face images
  - with expression, pose, illumination variations
  - 200 training, 200 test
- Images
  - Identity: Equal performance with hand work
  - Expression: Lower recognition rate than human
- Image Sequences
  - Stable Estimate of identification

Conclusion

- Utilize shape and whole appearance information
  - succeed to use all the information
- Apply LDA to AAM parameters
  - succeed to decouple ID parameters and non-ID parameters
- Use a specific intra-class scatter matrix from image sequences
  - improve the stability of ID recognition

⇨ Provide a basis for scene interpretation of face images