



# Biometric Systems Topics

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## 1 Introduction

- Kind of Biometrics
- Kinds of Performance Measurements

## 2 Pattern Recognition

- Gabor Filters, Gabor Wavelet Transform
- Edge Histogram Descriptor
- Local Descriptors
  - Algorithm
- SIFT, SURF
  - Algorithm
- PCA
  - Idea
  - Algorithm
- Kinds of Classification
  - Bayesian
  - Gaussian
  - Gaussian Mixture Models
    - Expectation Maximization
- Taxonomy of Classification
- Instance based Learning

## 3 Finger Print Recognition

- Ridge Patterns, components
- Minutiae
  - Kinds of minutiae
  - Poincare Index
  - Core Detection
  - Minutiae Extraction Approach
- Matching
  - Correlation-based
  - Minutiae-based
    - Idea
    - RANSAC
  - Ridge feature-based
  - CNN based
  - Pre-Alignment

## 4 Iris Recognition

- Anatomy?
- Iris Recognition
  - Iris Segmentation (Algorithm!)

- Rubber Sheet Model
- Measuring Performance
  - FHD
  - Degrees of Freedom
  - Decision
  - FAR
- Recent Challenges
  - Non-cooperative IRIS matching
  - Local Binary Pattern Histogramm
- Pros & Cons of IRIS Biometrics

## 5 Face Recognition 1

- Advantages, Challenges
- Closed Set vs Open Set Identification
  - Performance metrics
    - FR, FA
    - ROC
- Preprocessing
- Holistic approaches
  - Eigenfaces
    - PCA Algorithm
    - Eigenfaces Training/Testing
    - Faceness, Face space
  - View-based Eigenspaces
  - Bayesian Face Recognition
  - LDA/Fisherfaces
- Local/fiducial approach
  - Local/Modular PCA
  - Gabor Wavelet Transformation (Elastic Bunch Graphs)
  - Local Binary Pattern Histogram
  - (High dimensional local feature extraction)

## 6 Face Recognition 2

- Recognition across Pose
  - Geometric pose normalization
  - 2D active appearance model
  - 3D face Model fitting
- DNNs for face recognition
  - DeepFace
  - FaceNet
    - Inception Module

- Triplet Loss/Metric Learning

## 7 Soft Biometrics

- Gait
  - Avg Silhouette Signature
    - Algorithm
- Others
  - Semantic Descriptors
    - Pro/contra
  - Commonly used features
  - Age estimation
    - Basic Approach
    - 2-stage regression
  - Semantic Attribute recogn.

## 8 Multi Biometrics

- Multimodal vs Crossmodal
- Multi-modal
  - Intra-modal / Multi-modal
  - Fusion Levels
  - Face-Ear
  - Face-Fingerprint
- Deep Perceptual Mapping

## 9 Attacks

- Spoofing/Artificial Samples
- Coercive attack
- Impersonation attack
- Replay attacks
- DoS, database changes
- Font-End Attacks
- Back-End Attacks
- Others
- Counter-attacks

## 10 Standards

- Performance Testing
  - FMR, FNMR (identification)
  - FAR, FRR (verification)
  - FTC, FTE, FTA