

# Tutorial 9

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COMP435p  
Biometrics Authentication

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# Table of Contents

## 1 Problems

- Problem 1: Answer The Questions
- Problem 2: Feature set of voice identification
- Problem 3: Directional frontier
- Problem 4: Features of signature



# Outline

## 1 Problems

- Problem 1: Answer The Questions
- Problem 2: Feature set of voice identification
- Problem 3: Directional frontier
- Problem 4: Features of signature

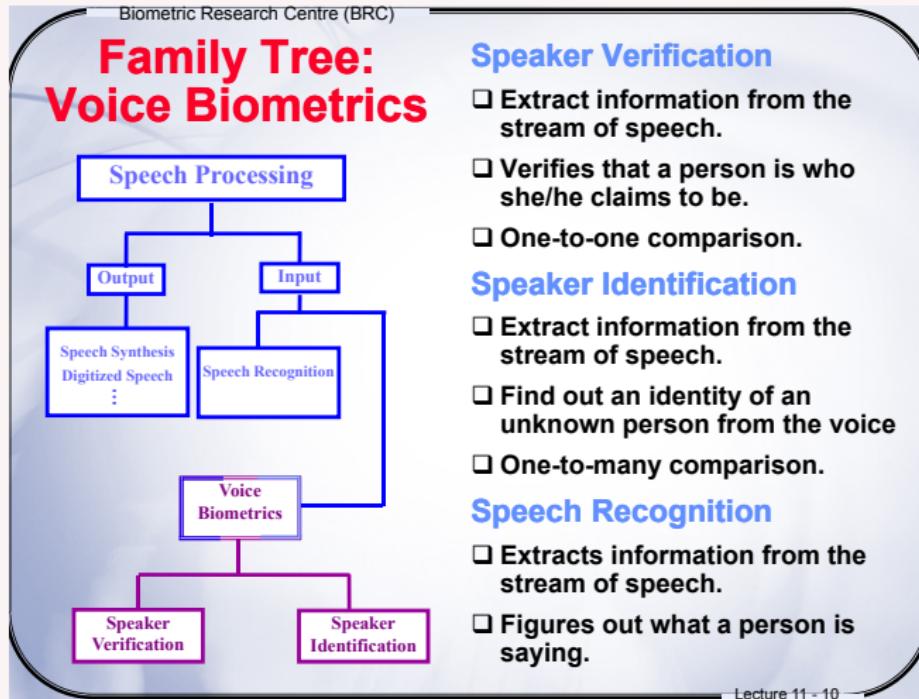


# Problem 1.1 Voice biometrics

*Understand the difference between voice biometrics and speech recognition? (P11:10). What is text-dependent and text-independent speaker ID? (P11:11).*



# Problem 1.1 Voice biometrics





# Problem 1.1 Voice biometrics

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## Background

### Text-dependent speaker ID

- ◆ Provide utterance of key words or sentences that are the same for training and recognition.
- ◆ Example: Precept(Six Words) of Monk- “唵、嘛、呢、叭、咪、吽”  
唵 (an) 嘛 (ma) 呢 (ni) 叻 (ba) 咪 (mei) 吼 (hong)

### Text-independent speaker ID

- ◆ Verifies the identity of the individual who is speaking.

### The performance (of verification) can vary according to:

- ◆ The quality of the audio signal
- ◆ Ambient noise
- ◆ The variation between enrollment and verification devices

### So, the acquisition process usually uses the same device where the verification will take place.

Lecture 11 - 11



# Problem 1.1 Voice biometrics

- Differences
  - Voice biometrics focuses on the identity of the speaker, different content of key words could be used; speech recognition focuses on the content of the speech, no matter who is speaking.
- Text-dependent speaker ID
  - The utterance of key words or sentences are the same for both training and recognition.
- Text-independentspeaker ID
  - To verify the identities of the people by the way they speak.





## Problem 1.2 Signature recognition

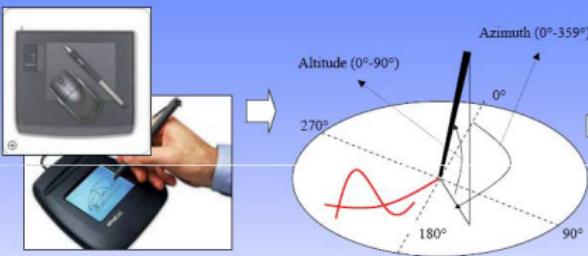
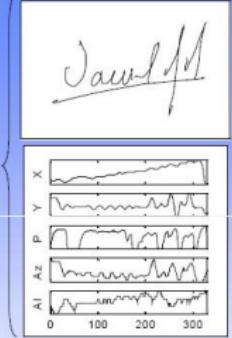
*Generally speaking, on-line signature recognition is more accurate than off-line. Can you give some reasons? (P10:6-7)*



# Problem 1.2 Signature recognition

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## Offline & Online Signature

- On-Line:  
  
A diagram illustrating an online signature capture setup. It shows a hand holding a tablet with a stylus, connected to a monitor displaying a signature. Above the tablet, a circular coordinate system indicates orientation with axes labeled Altitude (0°-90°), Azimuth (0°-359°), and 0°. A red wavy line represents the path of the stylus.
- Off-Line  
  
A diagram illustrating an off-line signature capture setup. It shows a hand writing a signature on a piece of paper. An arrow points to a scanner icon, followed by another arrow pointing to a scanned signature of "Paola Garcia".



# Problem 1.2 Signature recognition

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## Signature Recognition

### Two approaches:

- Offline (static)
- Online (dynamic)

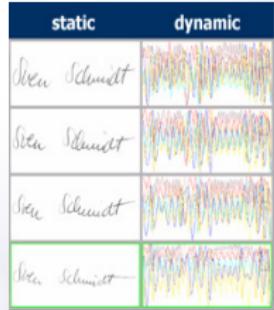
### Offline signature verification:

- Input: image
- Features: Shape of the signature
  - line densities, loops, upstrokes, types of arches, enclosed areas etc



### Online signature verification

- Input: Sign on pressure-sensitive tablets
- Features: Time element & shape
  - speed, acceleration, pressure, x/y location, pen tilt etc.



Lecture 10 - 7



# Problem 1.2 Signature recognition

- Advantages of online solution
  - pressure
  - speed, acceleration





## Problem 1.3 Pros and cons

*What are the advantages and disadvantages of voice and signature biometrics, respectively? (P10: 34; P11: 27)*



# Problem 1.3 Pros and cons

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## Signature Summary

### Strengths

- High user acceptance since it is similar to the existing pen based signature method.
- Resistant to impostors
- Leverages existing processes
- Perceived as non-invasive
- Users can change signatures

### Weaknesses

- Inconsistent signatures lead to increased error rates
- Users are unaccustomed to signing on tablets
- Has limited applications
- Change over time
- Professional forgers may be able to reproduce signatures
- Some people cannot produce stable signatures, even successive impressions

Lecture 10 - 34



# Problem 1.3 Pros and cons

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## Voice Summary

### Strengths

- ❑ Unlimited data collection
  - ◆ In contrary to fingerprints, face, ear, etc
- ❑ Collectable, user friendly (unobtrusive)
  - ◆ Well accepted by users
- ❑ Economical
  - ◆ Cheap equipment
- ❑ Widely used
  - ◆ Deployed on existing telephony system
- ❑ Location dependent



### Weaknesses

- ❑ Affected by external environment
  - ◆ Noisy environment
  - ◆ Health condition of users (e.g. heavy colds)
- ❑ Degradation of voice quality
  - ◆ Through microphone, digitizers, communication channels
- ❑ Behavioral nature of voice
  - ◆ Affected by stress, fatigue, tempo of the speaker



Lecture 11 - 27



# Problem 1.4 Two features of signature verification

*Show both global and local features for on-line signature verification. (P10: 23)*



# Problem 1.4 Two features of signature verification

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## Features Analysis

### Global Feature

- Features refer to the signature as a whole  
e.g. signing speed, signature bounding box
- Easy to extract and compute
- Lack discriminative power

### Local Feature

- Features refer to specific sample point along the trajectory of signature
- $x$  and  $y$  offsets relative to the first point on the signature trajectory
- $x$  and  $y$  coordinate difference between two points
- Curvature differences between two points

Lecture 10 - 23



# Outline

## 1 Problems

- Problem 1: Answer The Questions
- **Problem 2: Feature set of voice identification**
- Problem 3: Directional frontier
- Problem 4: Features of signature

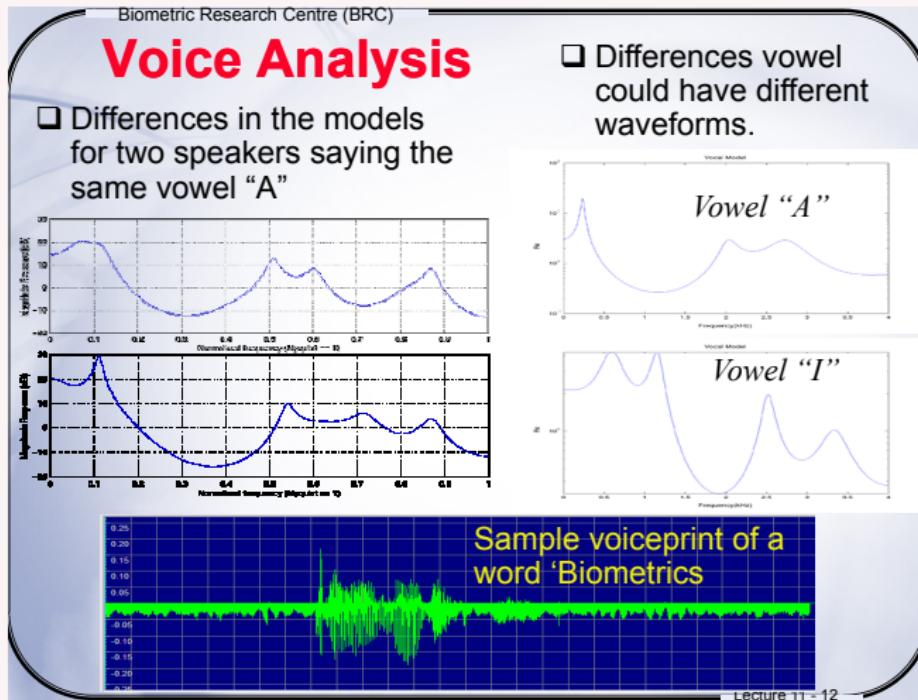


## Problem 2: Feature set of voice identification

*Features used by voice identification include cadence, frequency, pitch & tone of an individual's voice. In P11:12 the models for two speakers saying the same vowel are given. Please try to define a minimum feature set to divide the two models.*



# Problem 2: Feature set of voice identification



(frequency, magnitude)



# Outline

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- Problem 4: Features of signature



## Problem 3: Directional frontier

*Directional frontier (DF) is a directional grouping of the contour pixels. In P10:25, there is an example of DF curve characterization. Please give the corresponding feature set.*



# Problem 3: Directional frontier

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## Directional Frontier Feature (DF)

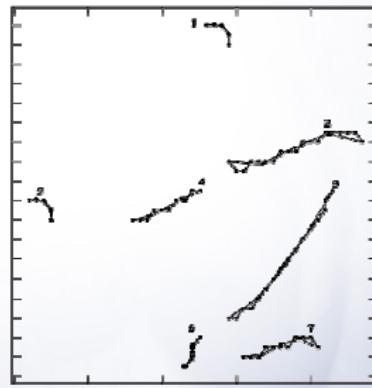
- DF is a directional grouping of the contour pixels

Pixel labeling



(a)

Curve tracing



(b)

Lecture 10 - 25



# Problem 3: Directional frontier

- end points
- angle (major orientation)
- skew (line of best-fit)
- via points
- spline curve
- middle point
- number of points





# Outline

## 1 Problems

- Problem 1: Answer The Questions
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# Problem 4: Features of signature

*Please write down your signature. Based on the definitions given in P10:11-14, please find the following features: Upper/lower envelop, vertical/horizontal projection, geometric and topological features.*



# Problem 4: Features of signature

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## Stage 3: Feature Extraction



- ☛ The features extracted from signature image includes: the **upper** and **lower** envelop, and the vertical and horizontal projection
- ☛ Upper and lower envelop: the curve connecting the most up or low pixel of the signature trajectory
- ☛ Vertical and horizontal projection: the counting of black pixel per horizontal (or vertical) lines.

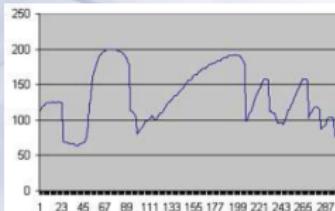
Lecture 10 - 11



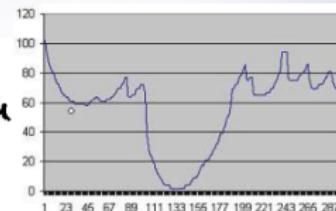
# Problem 4: Features of signature

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## Upper and Lower Envelop

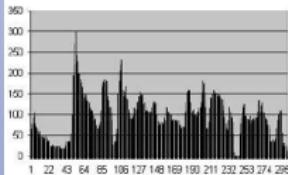


Upper Envelop

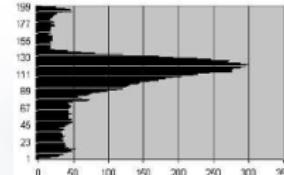
*SerjanJblu*

Lower Envelop

## Vertical and Horizontal Projection



Horizontal Projection Profile

*SerjanJblu*

Vertical Projection Profile

Lecture 10 - 12



# Problem 4: Features of signature

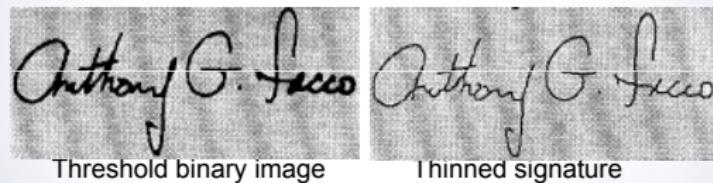
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## System Description

### (a) A Query Image



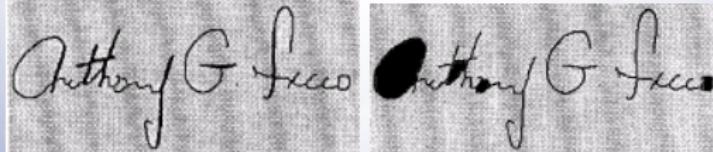
### (b) Preprocessing



Threshold binary image

I thinned signature

### (c) Geometric Features (horizontal/vertical bars and loops)



Lecture 10 - 13



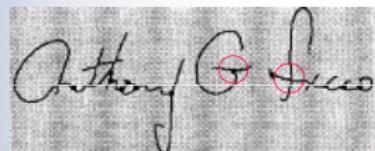
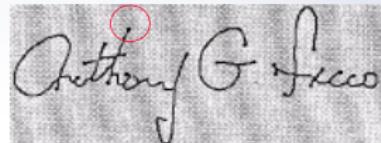
# Problem 4: Features of signature

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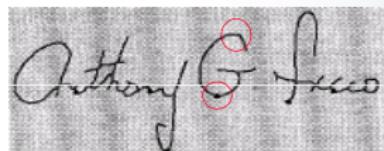
## System Description (2)

### (d) Topological Feature

End points

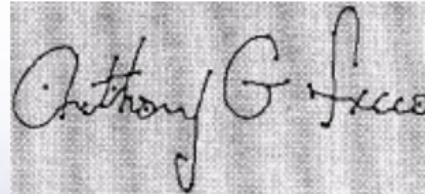


Branch points/Crossing points



Concave/Convex

### (e) Features Map



Lecture 10 - 14

# Q & A



Any questions?