

#### Online Signature Feature Extraction

József Németh

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# Online Signature Feature Extraction from Video





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Always reveals a man's character and sometimes even his name



## Introduction

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### Motivation

- Cheap, widely used device
- May contain more information
- Could be used with other devices
- Advantage: Real signature

### Goals

- What kind of features can be extracted?
- Which feature (or feature set) gives the best results?



# Video based verification

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# Recording

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# Tracking

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## Pen tip tracking

- Intersection of lines (Hough transformation)
- Refinement using template matching

### Pen angle

• Pen tracking using Hough transformation

### Reconstruction

- Camera calibration using pattern
- Precalibrated camera could be used in a real application



# Reconstruction

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# Reconstruction



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# Pen angle

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## Features

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Tracking

Results

## Pen tip tracking

- Conventional features
- Coordinates  $\rightarrow$  velocity  $\rightarrow$  acceleration
- Normalization

## Pen tracking

- Pen angular offset
- and its velocity

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# Comparison of data sequences

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## Dynamic Time Warping (DTW)

- Measures the similarity between two sequences
- Data vary in time and/or speed
- Also provides a pairing
- Dynamic programming



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Comparison

# DTW



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# Classification

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### The database

- 20 person
- 10-10 genuine signatures and 5-5 forgeries

## Learning

- Learning set from 5 randomly chosen real signatures (T)
- The remaining signatures will be classified.
- Unknown signature  $(s) \rightarrow$  real or forgery?



# Classification

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### Classification

- Average distance between the learning signatures  $(D_{avg}(T,T))$
- Average distance between the learning signatures and the unknown ( $D_{avg}(T,s))$
- The signature is accepted if

$$D_{avg}(T,s) < t \cdot D_{avg}(T,T)$$

where t is a fixed constant.



Online

## Error measuring

#### Signature Feature Extraction József Németh ontents troduction he method tecording racking comparison EER - equal error rate, where FAR and FRR are equal

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# Error measuring

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## Equal error rate

- Increasing the *t* threshold: FRR decreasing, while FAR increasing
  - Looking for *t*, where  $FRR=FAR \Rightarrow EER$



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# Error measuring

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## Equal error rate

• How EER changes as we increase the elements of the database?



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# Results

Simple features

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feature	EER
point-coordinates	11.1%
velocity	14.4%
acceleration	13.0%
angle	6.0%
Pen angle	17.7%

## Compound features

feature	EER
angle + pen angle	5.6%
angle + pen angle velocity	5.6%



# Future work

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### Future work

- Extraction of new features
  - Pen lifting detection
- Stereo camera calibration
  - 3D information
- Connect with other device
  - pen with accelerometer

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# Acknowledgement



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