Journée Biométrie, CAEN, 07 Juillet 2017

Hidden Biometrics and ageing:
from security to healthcare considerations

Amine NAIT-ALI
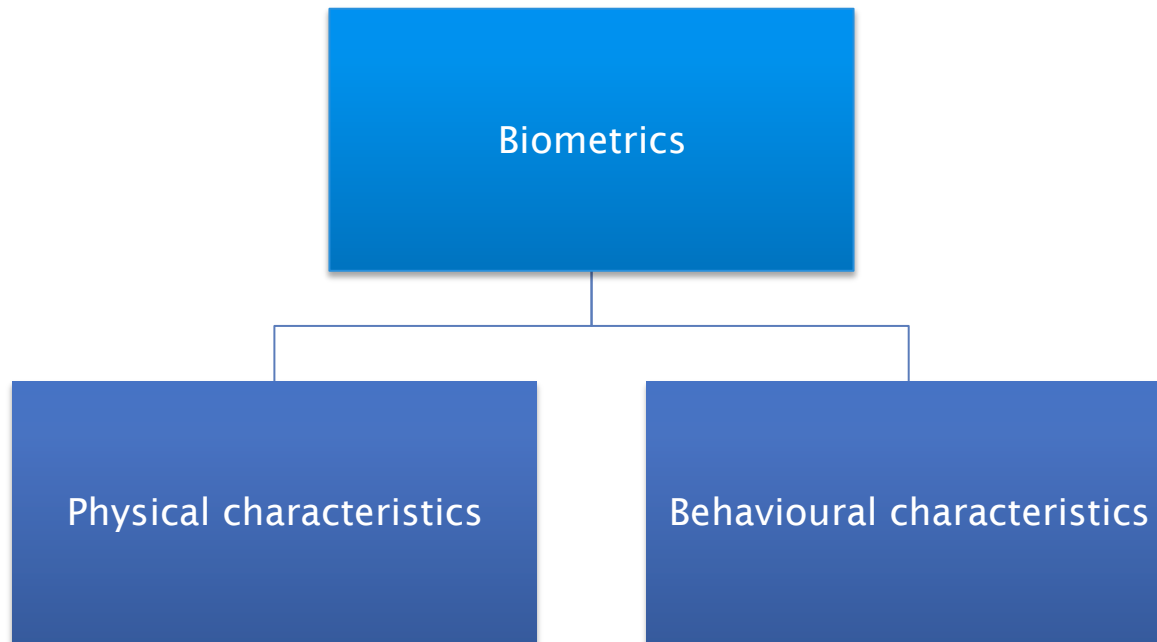LiSSi, Université Paris-Est Créteil
(UPEC)

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Introduction

Part A: Hidden biometrics (physical)

Part B: Hidden Biometrics (behavioural)

Conclusion

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Recognize persons from their physical or Behavioural characteristics

Facial Recognition
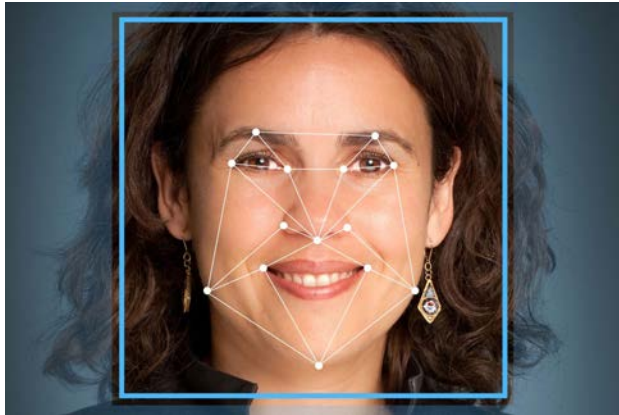
Ocular biometrics
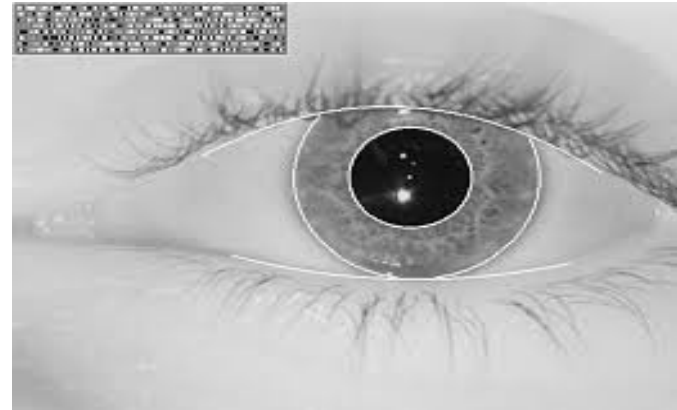
Voice

Fingerprint, Hand biometrics

Biometrics: spoofing issue
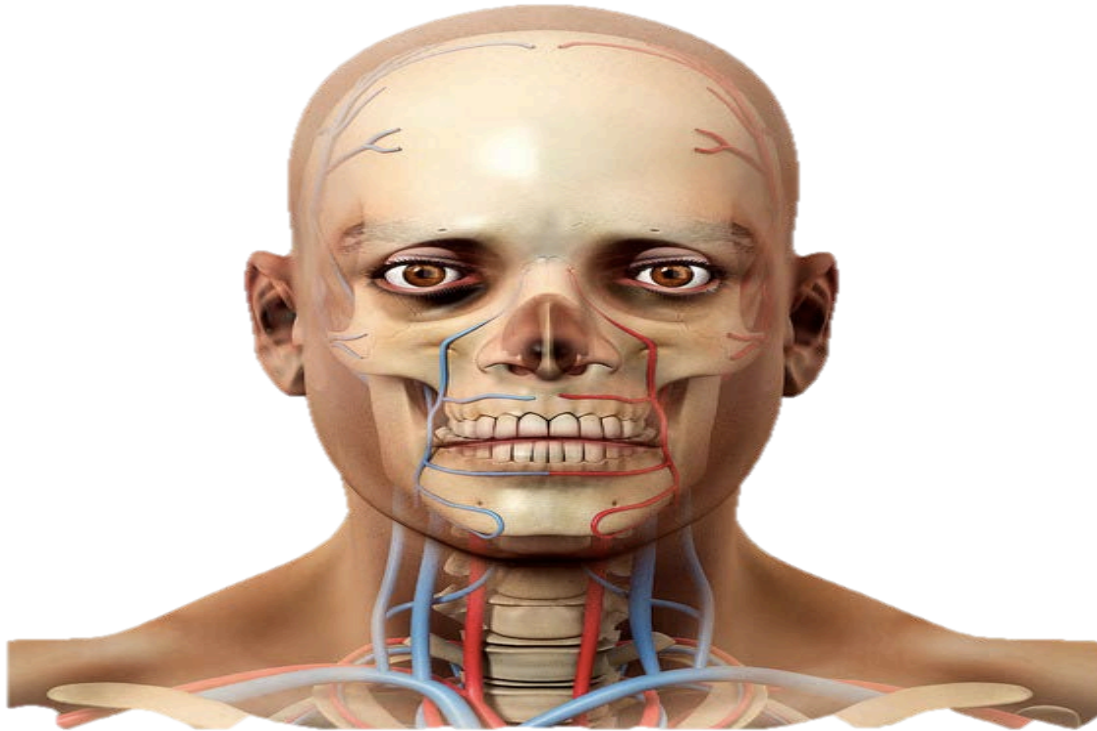
Fake fingerprint

Fake iris

Fake face: 3D mask

Video removed from the PDF file

Hidden biometrics uses data that are commonly employed in the medical field. Such methods are robust regarding spoofing. They need to be explored.
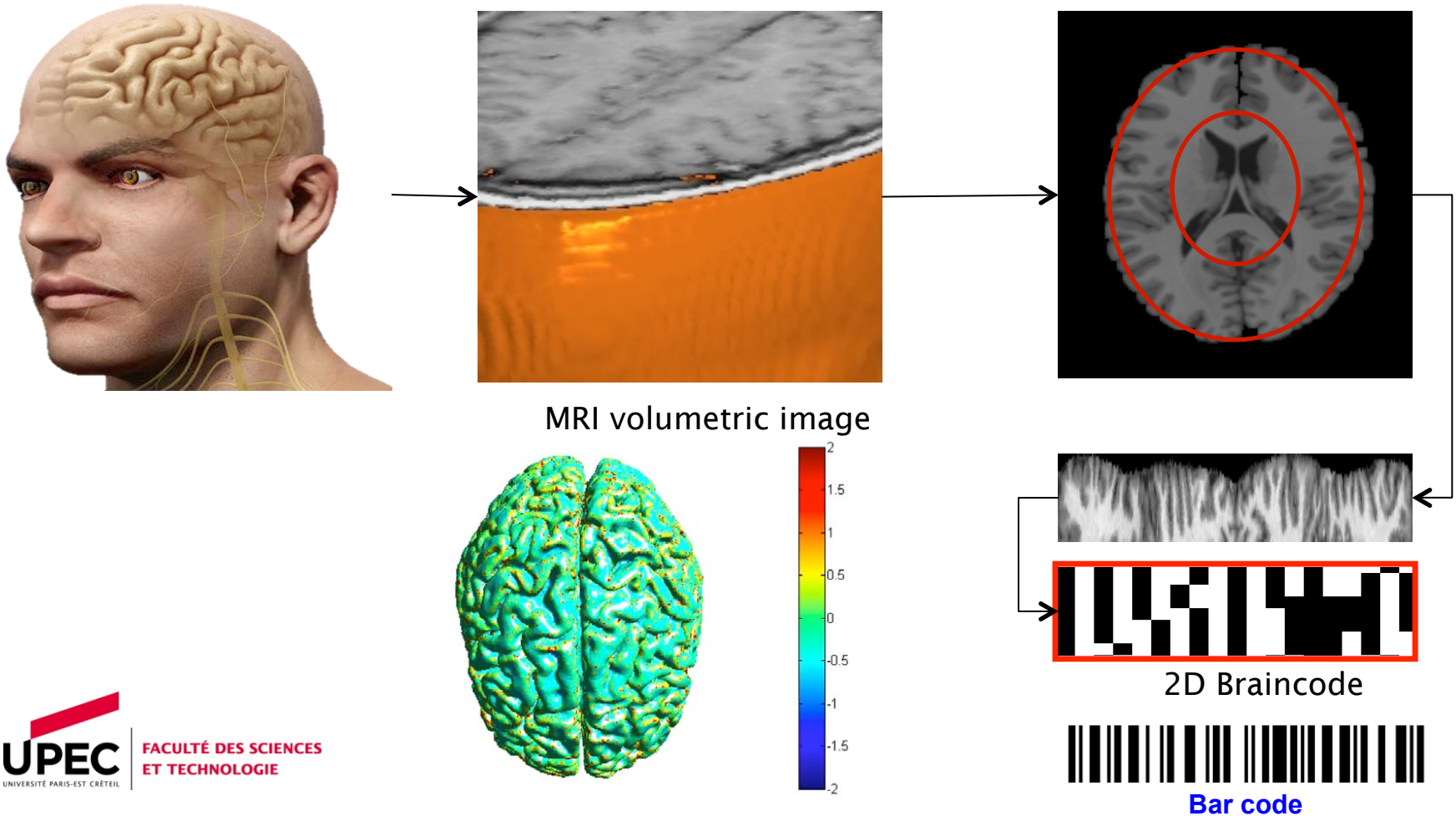
Dental Biometrics: X-ray Imaging

Dental radiograpy
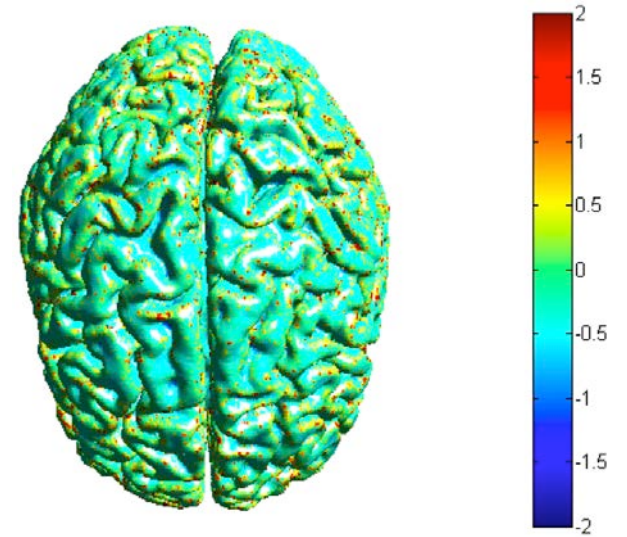
Identify individuals from their MRI brain imaging !

MRI volumetric image

2D Braincode

Bar code

9

3D Braincode extraction

Hand shape analysis   *Palmprint analysis*   *Hand vein analysis*

Biometric System based on Hand X-Ray images

Distal Phalanges

Intermediate Phalanges

Proximal Phalanges
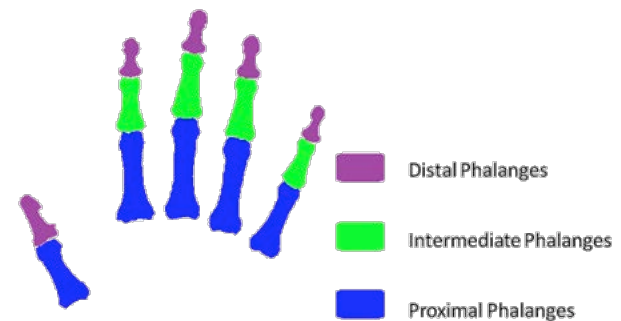
Y. Kabbara, A. Shahin, A. Nait-Ali, and M. Khalil, "An automatic algorithm for human identification using hand X-ray images," in *2013 2nd International Conference on Advances in Biomedical Engineering (ICABME)*, 2013, pp. 167–170.

Y. Kabbara, A. Nait-Ali, A. Shahin, M. Khalil, "Hidden Biometric Identification/Authentication based on Phalanx Selection from Hand X-Ray Images with Safety considerations", The fifth International Conference on Image Processing Theory, Tools and Applications, 2015, Orleans.

32 hand x-ray images
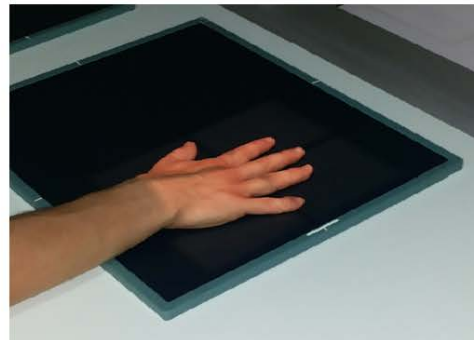
14 phalanges

1(µSv)
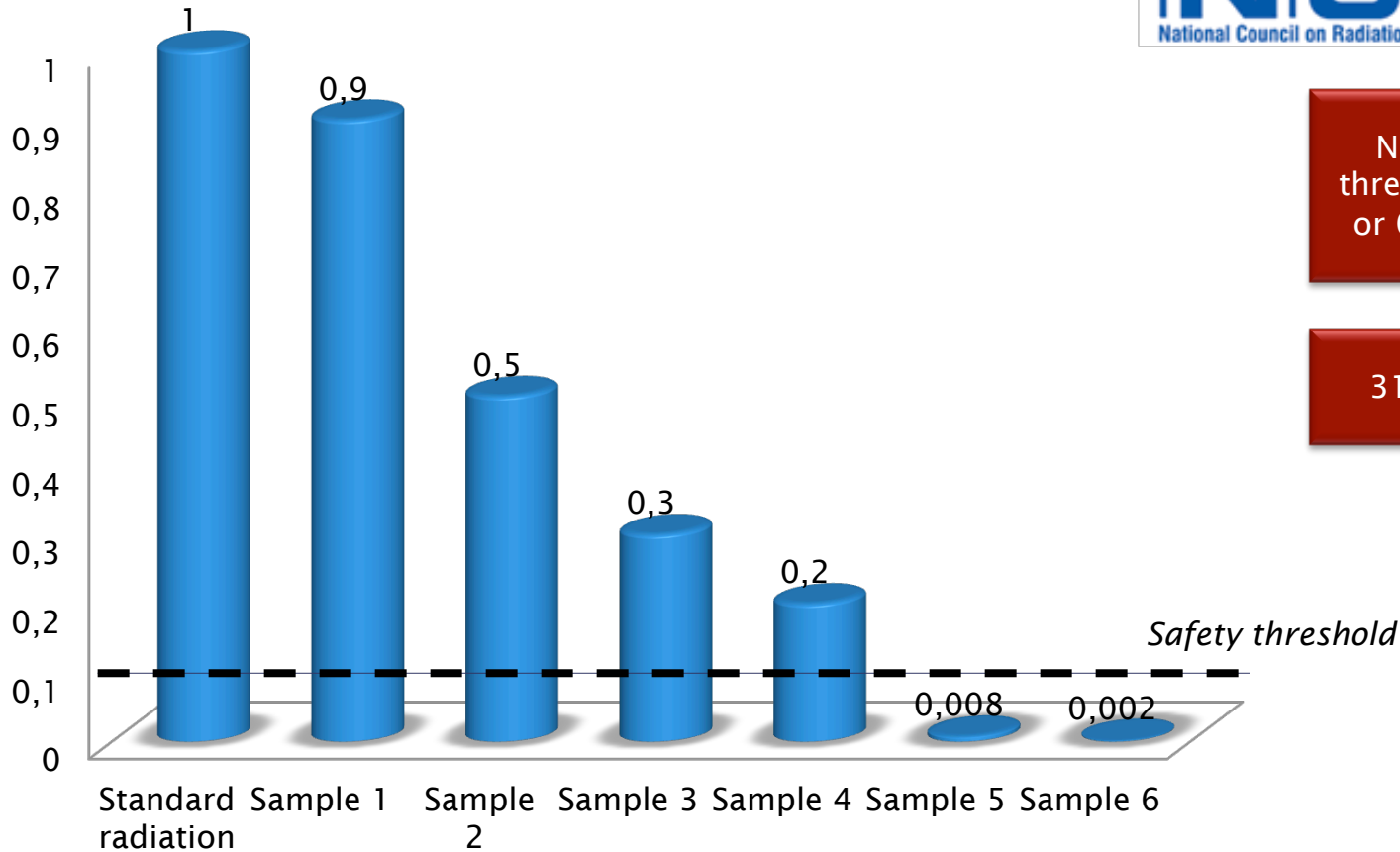
12

(a) (b) (c) (d) (e)

A sample from the standard acquisition process using an X-Ray machine (a) the machinery bloc, (b) the preparation/acquisition phase using an anti-radiation dress, (c) the platform control panel, (d) Cassette and (e) the transfer to a digital medium.

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Some standards in the medical field

Radiography modality	Dose (mSV)
Chest	0.1
Abdomen	0.7
Hip	0.7
Neck	0.2
Back (upper)	1
Back (lower)	1.5
Hands, legs,…	0.001
Mammography	0.4
Dental	0.005
Skull	0.1

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Safety considerations

NCRP: Administrative threshold 0.25 mSv / year or 0.1 μSv / acquisition

3125 acquisition/year

Safety threshold

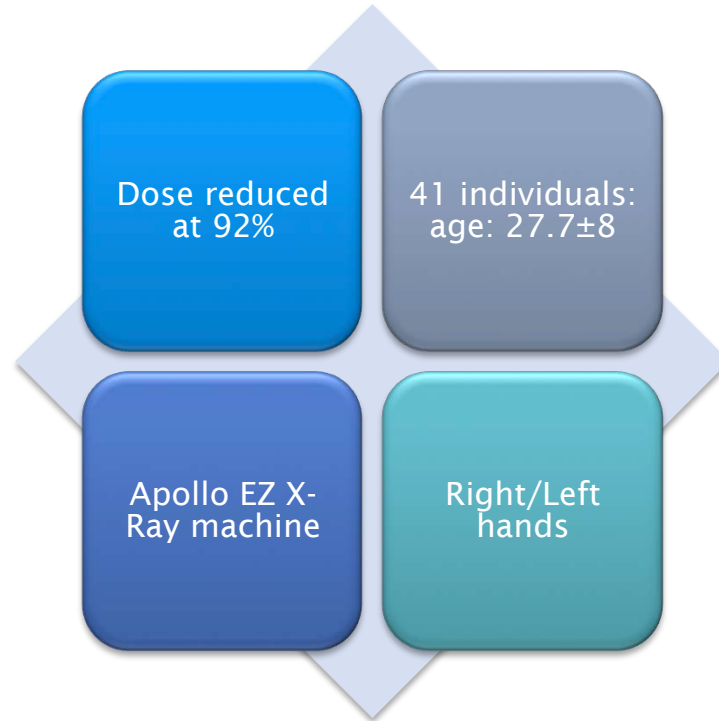Standard radiation: 1
Sample 1: 0,9
Sample 2: 0,5
Sample 3: 0,3
Sample 4: 0,2
Sample 5: 0,008
Sample 6: 0,002

Effective dose (µSV)

"SR1 Group"

"SR2 Group"

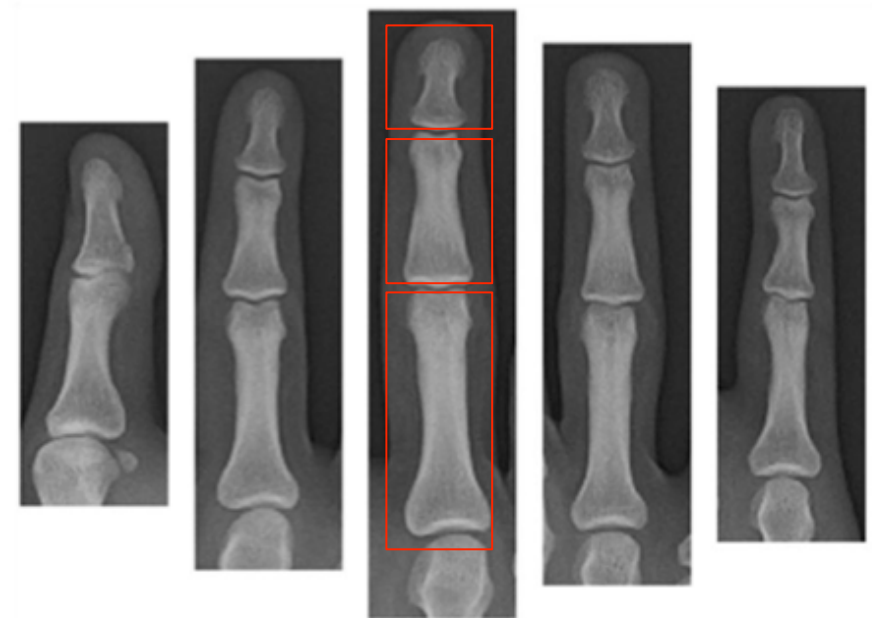| Dose reduced at 92% | 41 individuals: age: 27.7±8 |
| Apollo EZ X-Ray machine | Right/Left hands |

Several Samples of hand X-ray images with 92% of reduced dose, contains normal Right hands and various hand geometric positions

Input image

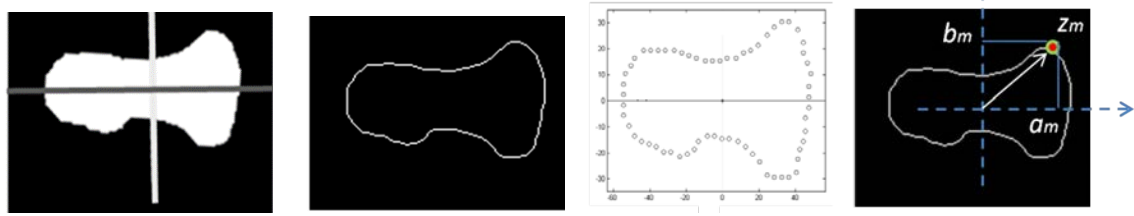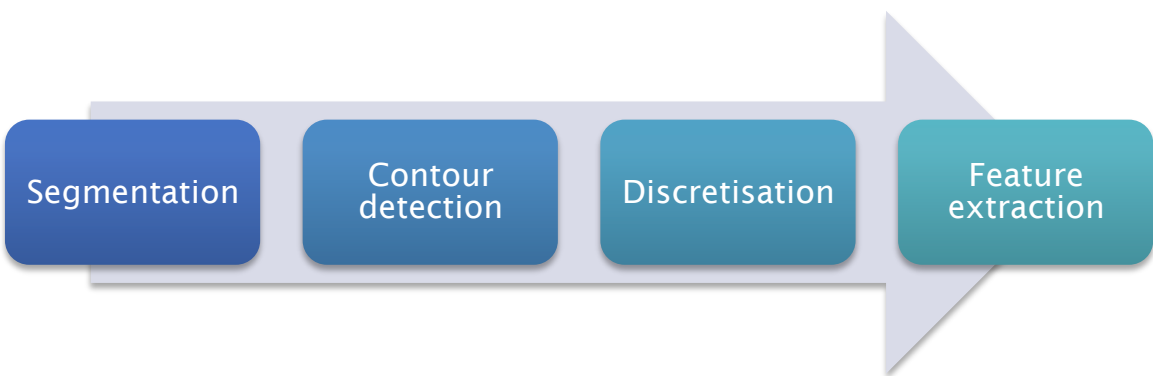*Pre-processing*
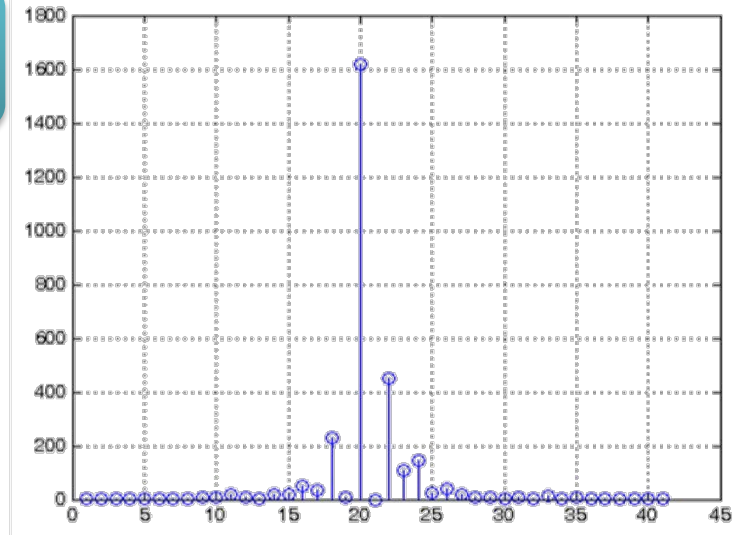
Segmentation → Contour detection → Discretisation → Feature extraction

Phalanx processing phases

Fourier descriptors module

Database
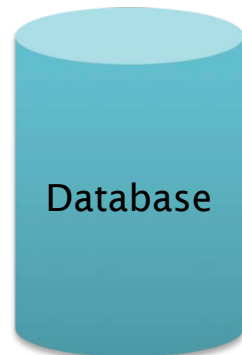
Template
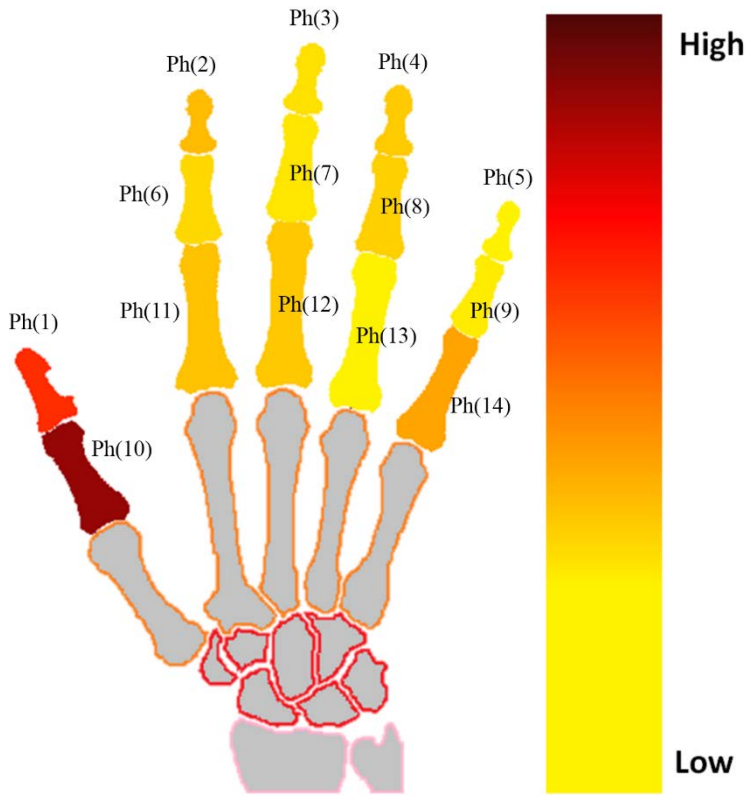
An example of Phalanx reconstruction by varying the number of selected spectra *P*.
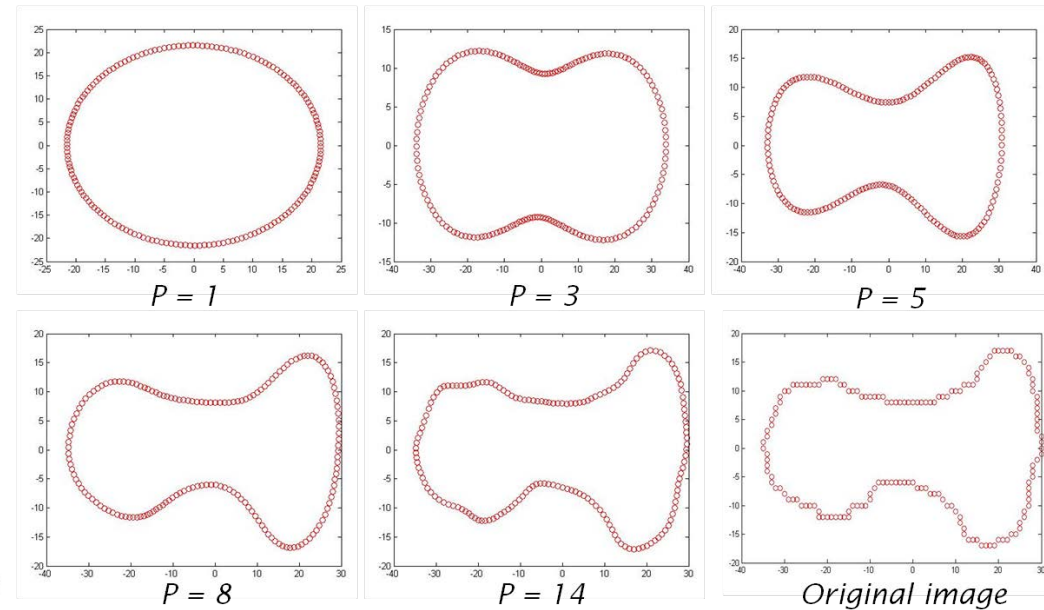
The average distribution of errors (%) of the 14 phalanges for each two images of the same person influenced by hand position and by radiation reduction

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FAR and FRR

Performance evaluation using FAR and FRR with EER = 0% when we use only 6 phalanges using "SR1" and "SR2".

Accuracy
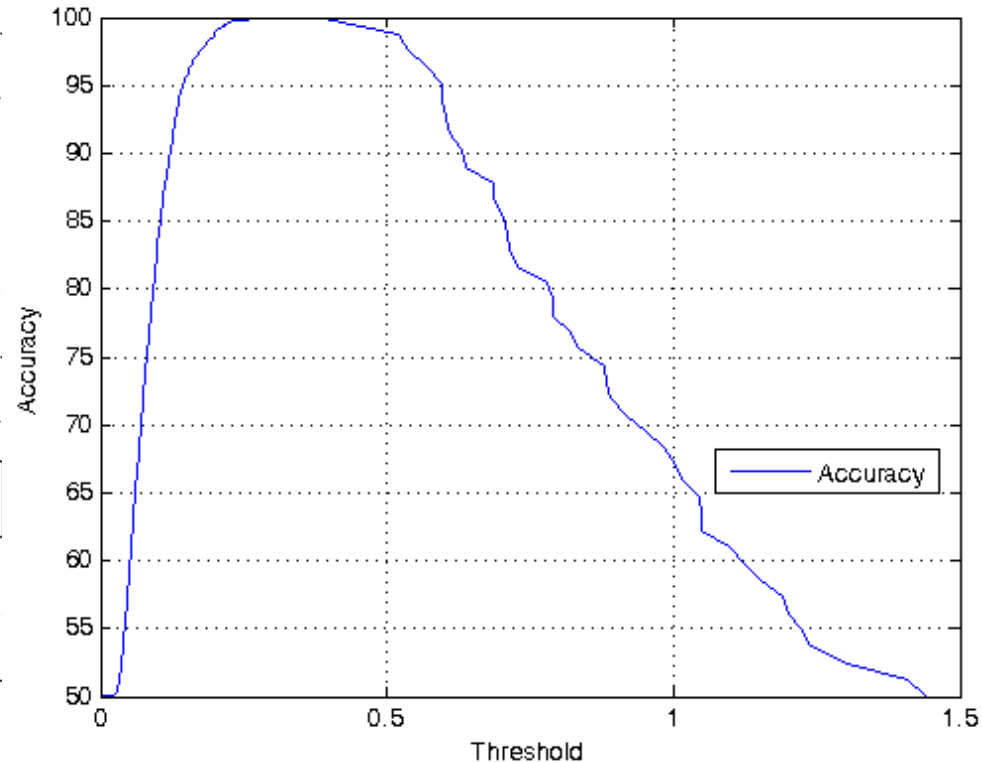
Accuracy varying with the threshold: The maximum achieved is 100% with EER = 0% using 5 Phalanges, using "SR1" and "SR2".

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Acquisition process using an X-Ray machine (a) classical capture system, (b) portable devices (photo. Internet)
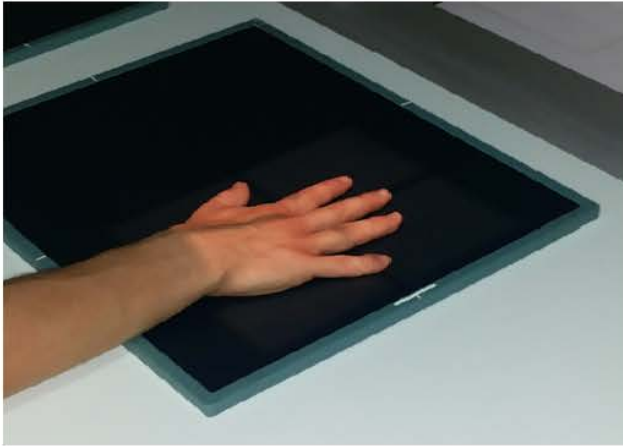
Results: Identification and Verification

	IDENTIFICATION RATE % Identification accuracy using "SR1" and "SR2"						THE EQUAL ERROR RATE (EER) % Verification Performance using "SR1" and "SR2"				
	P = 1	P = 2	P = 3	P = 4	P ≥ 5		P = 1	P = 2	P = 3	P = 4	P = 5
f = 1	39.0244	85.3659	91.4634	92.6829	92.6829	f = 1	6.9383	3.6477	3.3437	2.9879	2.7746
f = 2	84.1463	98.7805	98.7805	98.7805	100	f = 2	3.268	1.1193	0.9902	0.5248	0.3984
f = 3	91.4634	100	100	100	100	f = 3	1.6948	0.5072	0.4114	0.2642	0.2441
f = 4	98.7805	100	100	100	100	f = 4	0.4865	0.131	4.0E-05	0	0
f = 5	98.7805	100	100	100	100	f = 5	0.3523	0	0	0	0
f = 6	100	100	100	100	100	f = 6	0.1162	0	0	0	0
f = 7	100	100	100	100	100	f = 7	0.1216	0	0	0	0
f = 8	100	100	100	100	100	f = 8	0.1172	0	0	0	0
f = 9	100	100	100	100	100	f = 9	0.3377	0.1122	0.1098	0.0942	0.0876
f = 10	100	100	100	100	100	f = 10	0.1627	0.1094	0.1059	0.0843	0.078
f = 11	100	100	100	100	100	f = 11	0.1186	0.1128	0.1093	0.0833	0.0777
f = 12	98.7805	98.7805	98.7805	98.7805	98.7805	f = 12	1.1834	0.8789	0.8617	0.8437	0.8242
f = 13	98.7805	98.7805	98.7805	98.7805	98.7805	f = 13	1.465	0.7542	0.7173	0.7114	0.7069
f = 14	98.7805	98.7805	98.7805	98.7805	97.5610	f = 14	1.3344	0.6494	0.7517	0.9385	1.4716

P: Number of extracted parameters for each phalanx, *f*: Number of optimal selected phalanges

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Full body x-ray scanner

23
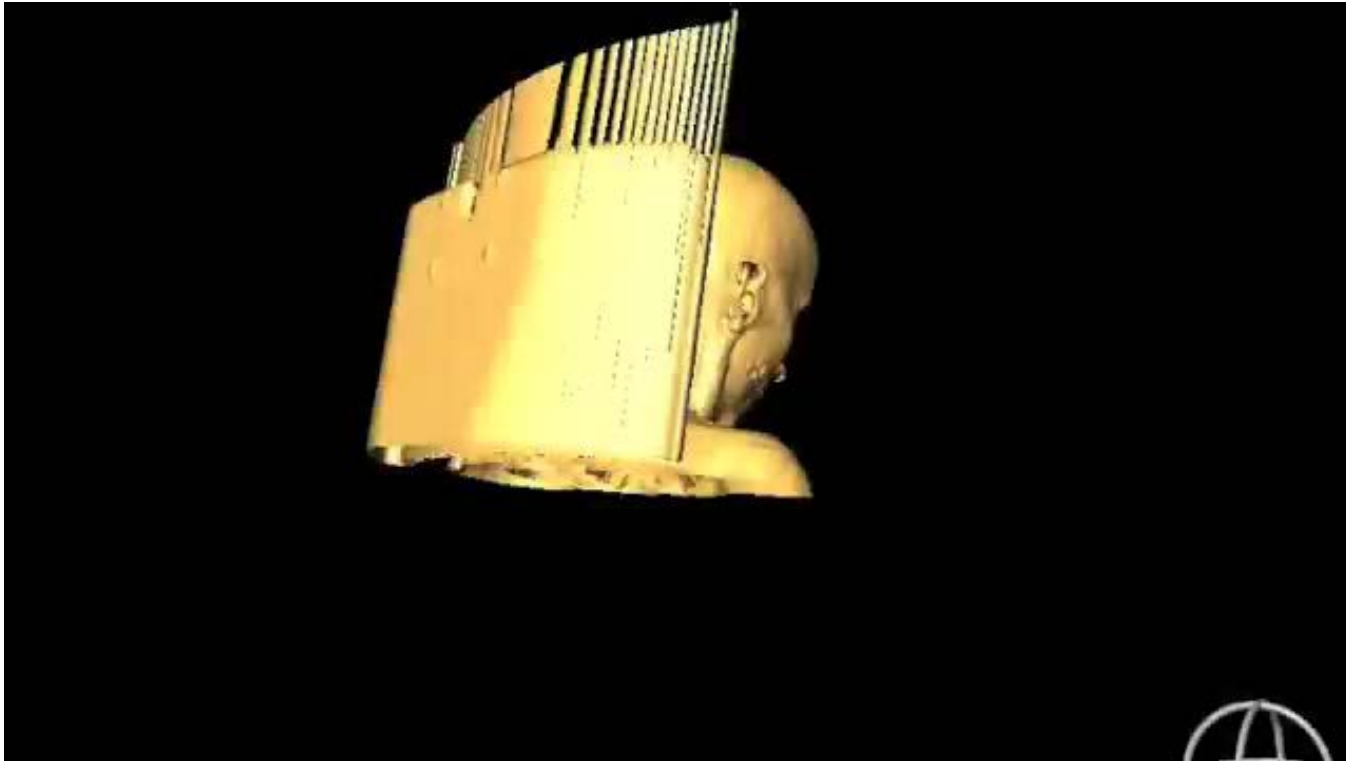
K. Aloui, A. Nait-ali, and S. Nacer "A novel approach based Brain Biometrics: some preliminary Results for Individual identification," IEEE Workshop on Computational Intelligence in Biometrics and Identity Management, Paris, France, April. 2011.

A. Nait-ali, "Beyond classical biometrics:when using hidden biometrics to identify individuals", 7th European workshop on Vision and Image processing, July, Paris, 2011.
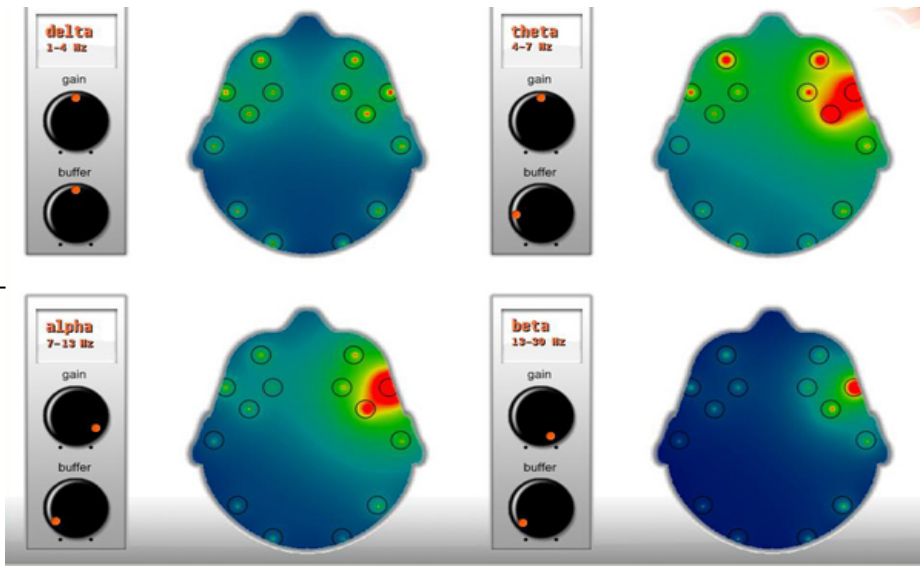
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Hidden biometrics as an anti-spoofing modality
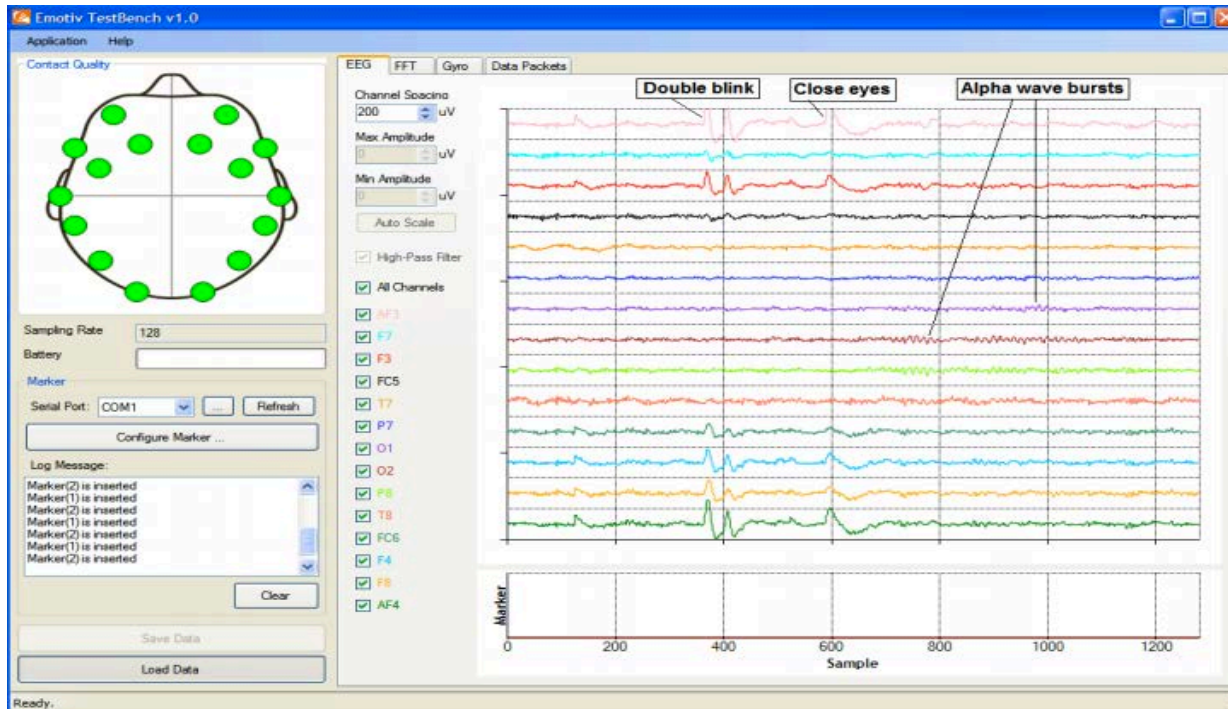
Multi-channel EEG signal analysis   (PhD thesis: D. Kerbaj)

EEG acquisition using EMOTIV system

Hidden biometrics as an anti-spoofing modality

EEG maps analysis.   (PhD thesis: D. Kerbaj)

EEG acquisition using EMOTIV system

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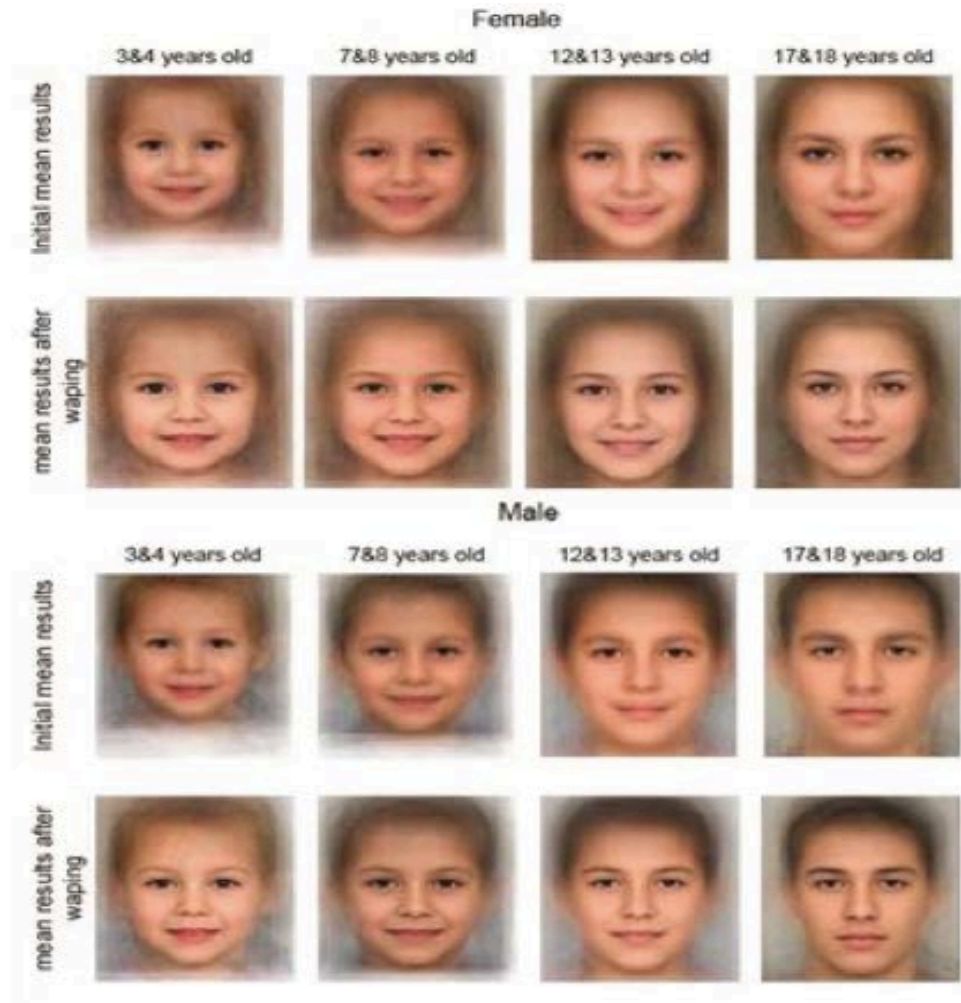How can we simulate the ageing using a predictive model?

Fig. 2. Mean faces of the people in the different ages and two genders. Results in the tope rows, for each gender, are initial mean results with only 5 points. The second rows show the mean faces calculated using all the extracted feature points.

28

PhD thesis: E. Farazdaghi

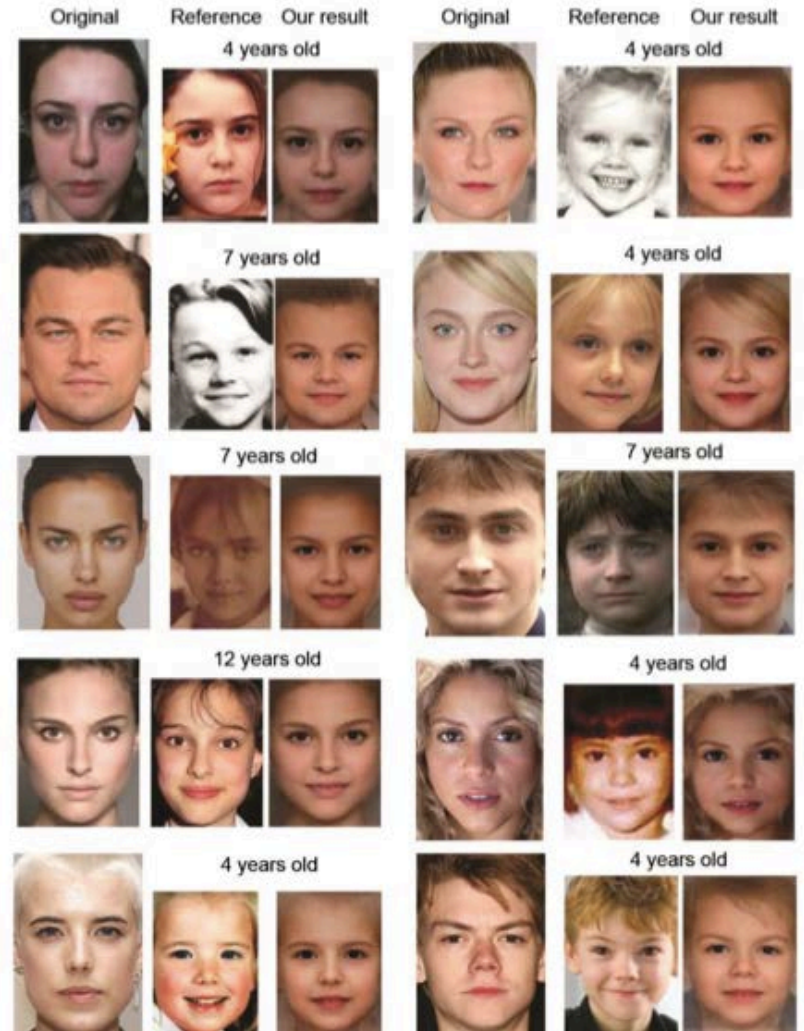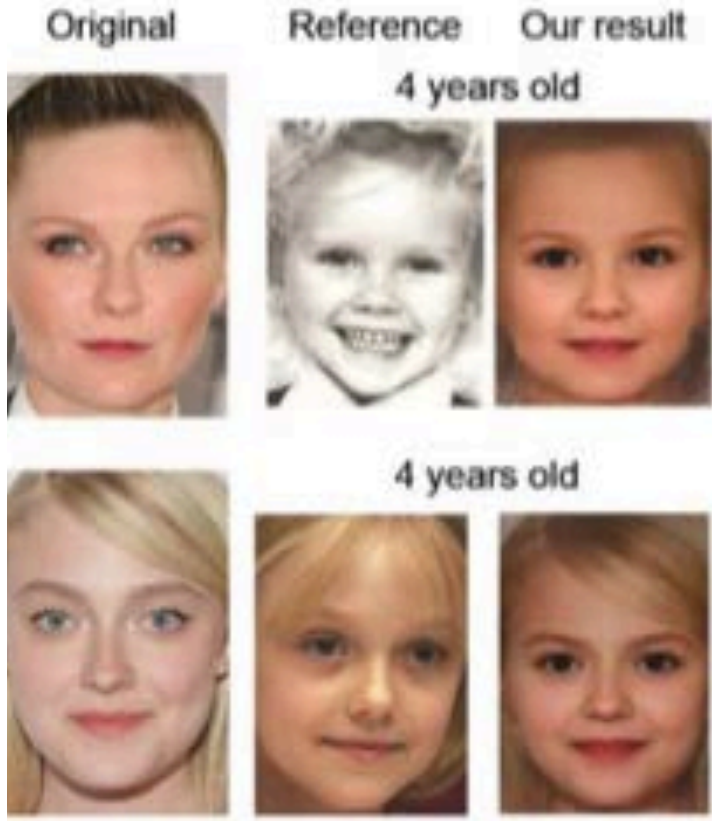# Face bacward predictive models
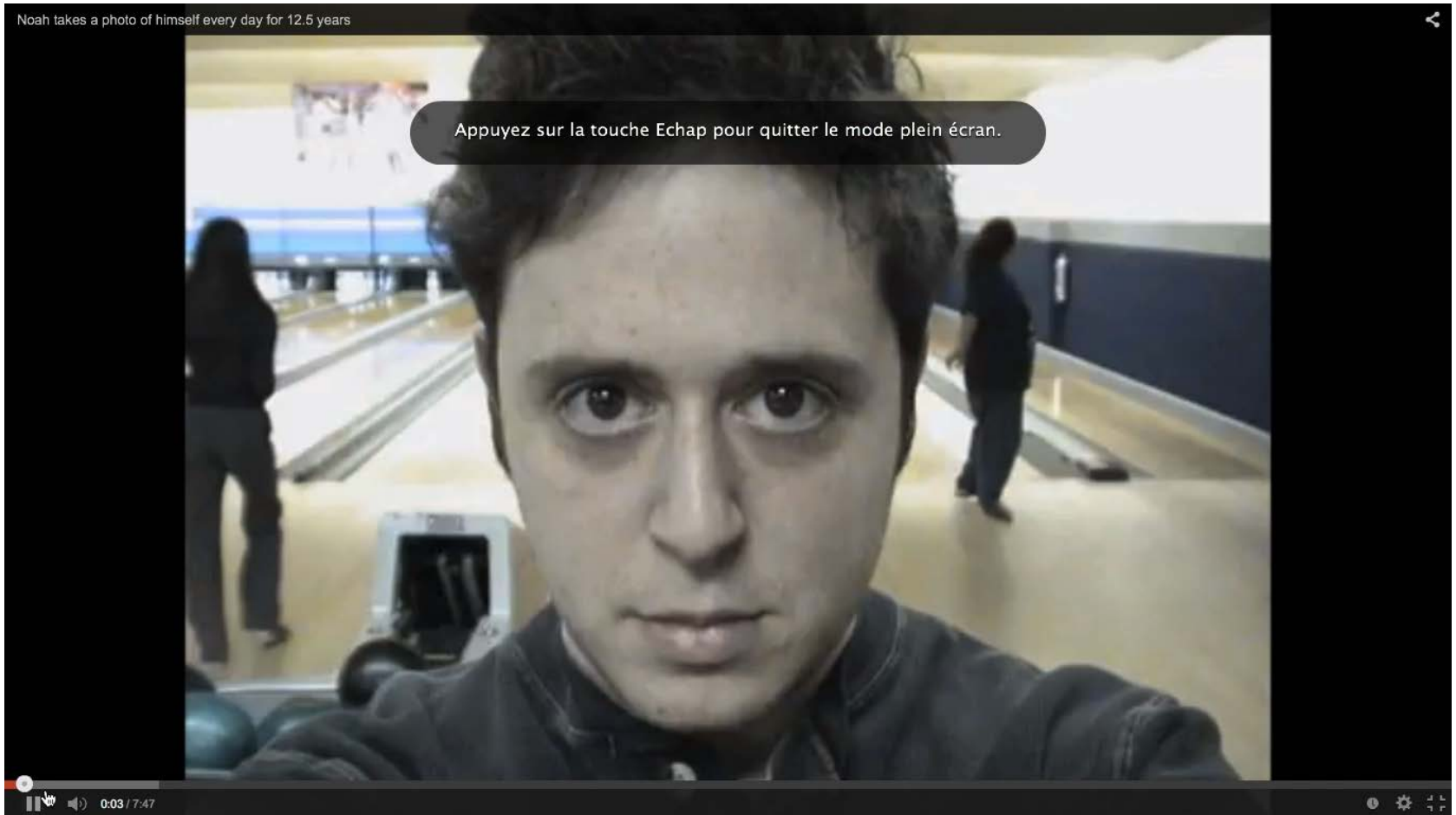

PhD thesis: Elham Farazdaghi

Fig. 3. The first column of each group is the input image, the second one is the reference and the third one is our result. Target ages are written on the top of comparable images

He took one pic a day during 12.5 years
https://www.youtube.com/watch?v=iPPzXlMdi7o

Some existing illustrations from the internet showing
Smoking effect on face appearance

Video removed from the PDF file

Drugs effect on face appearance

Video removed from the PDF file

Drugs effect on face appearance

The challenge is to study the effect of cigarettes, sun exposure, drugs, alcohol,… **on ageing process.**

Input image

Behavioural biometric parameters

Feedback

Ageing mathematical model

Output image

Age
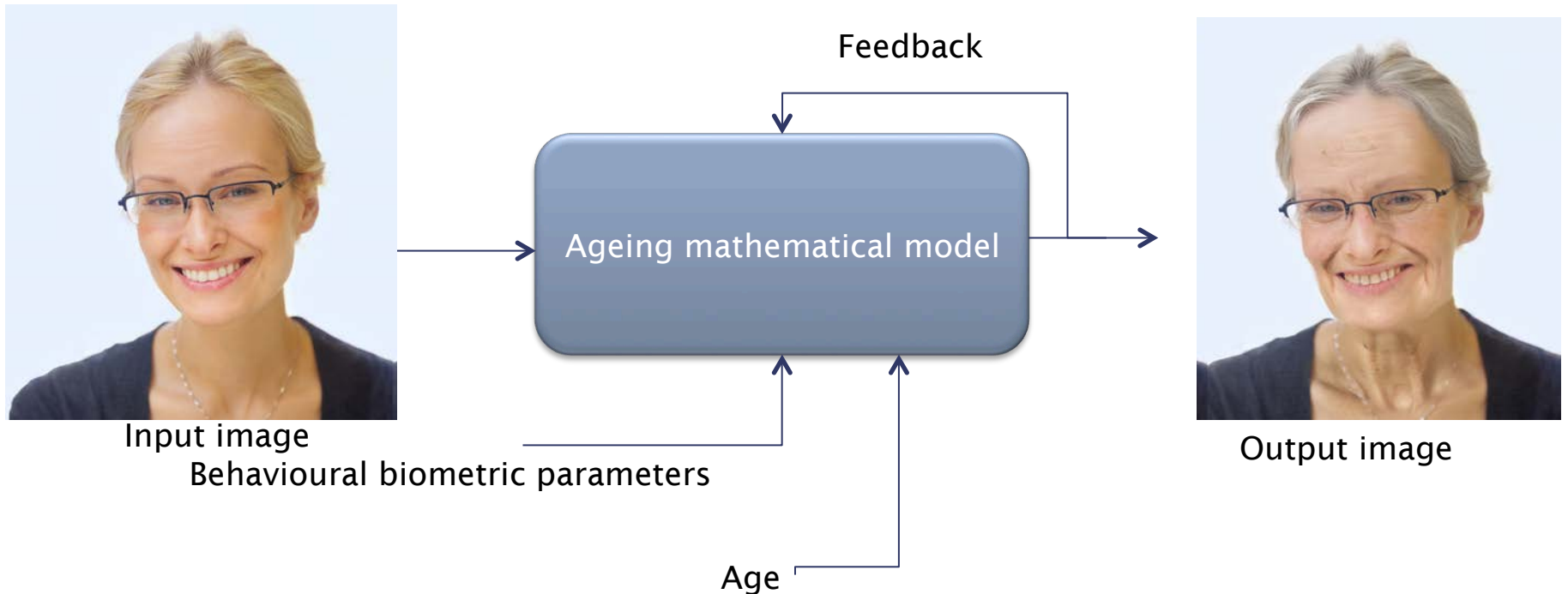
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