

Other Traits

COMP 388-002/488-002 Biometrics

Daniel Moreira

Fall 2023



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Today you will...

Get to know
Alternative traits and
soft biometrics.

Today's attendance

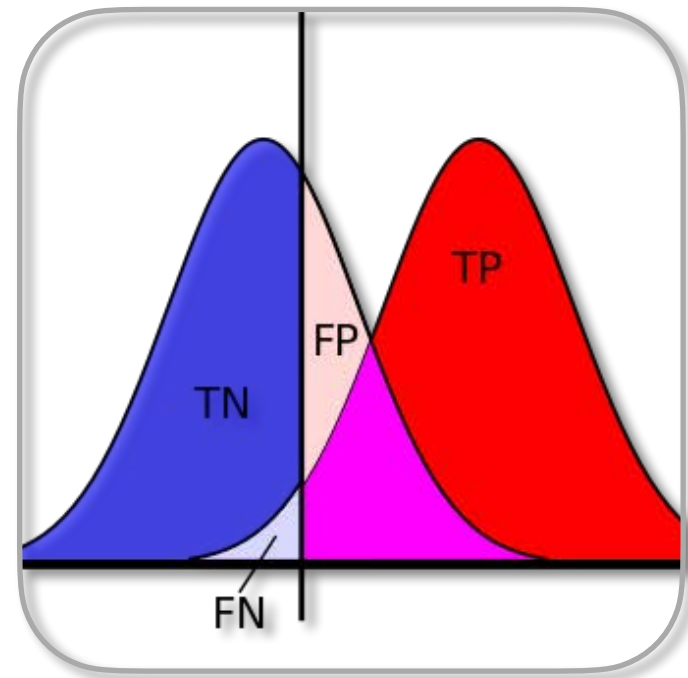
Please fill out the form

<https://forms.gle/6sqso2i72pwKgTc76>



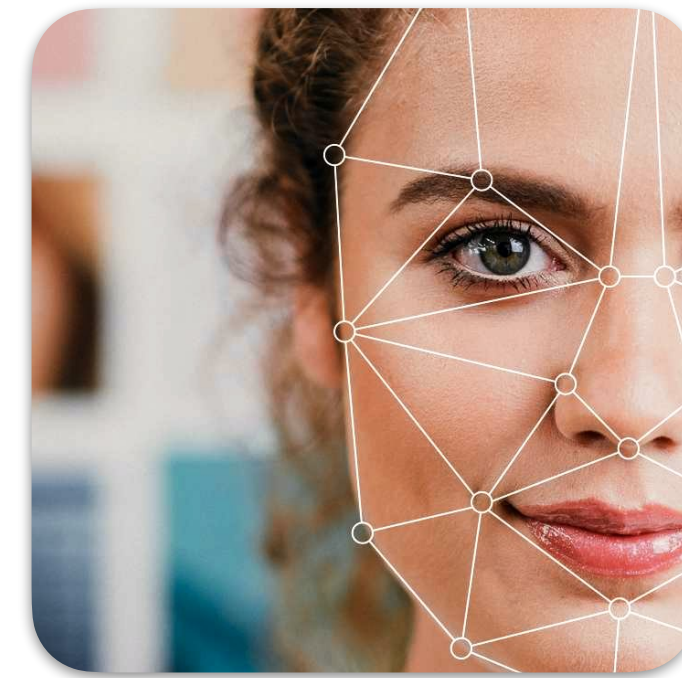
Course Overview

Content



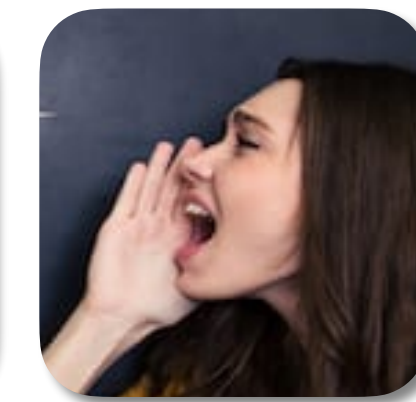
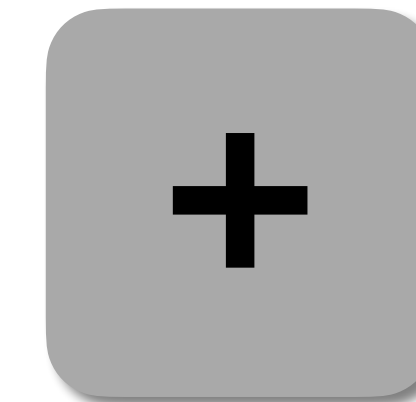
Basics

Concepts
Metrics
Metric
implementation



Core Traits (3)

Concepts
Baseline implementation
Data collection
Evaluation
Attacks
Assignments



Alternative Traits and Fusion Concepts



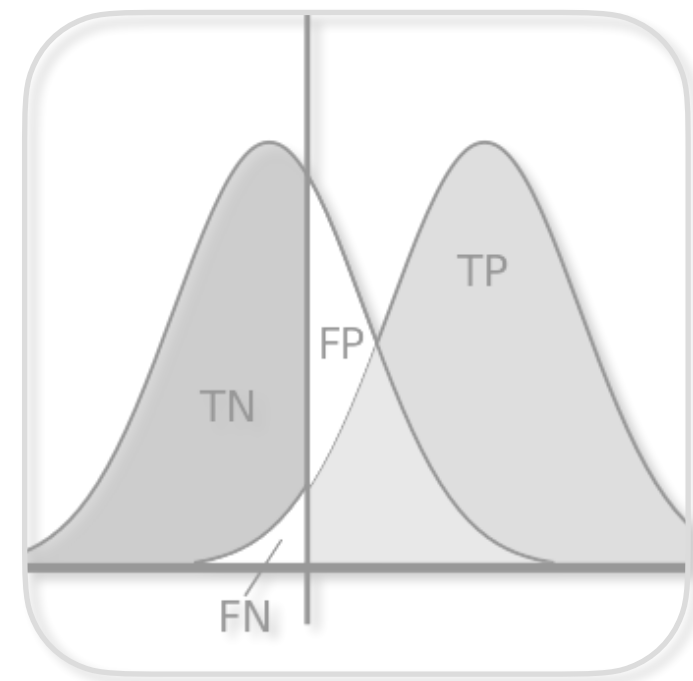
Invited Talks (2)
State of the art
Future work



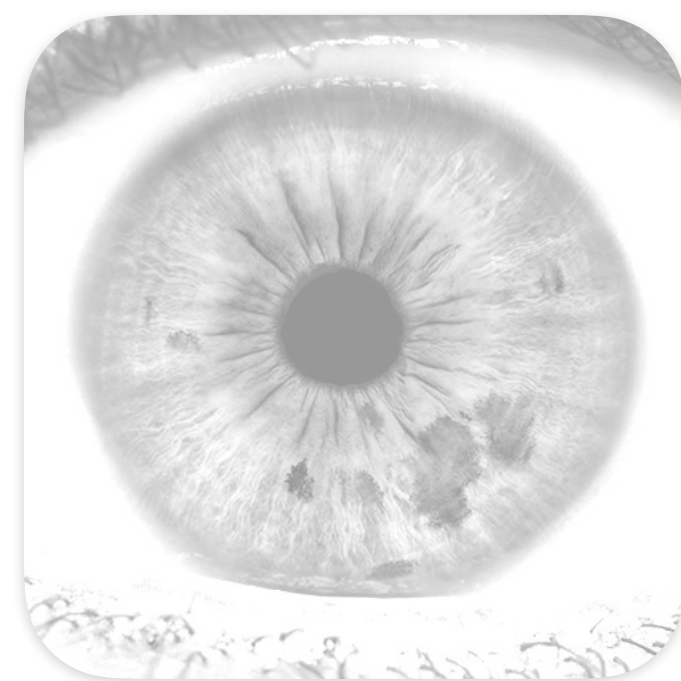
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Course Overview

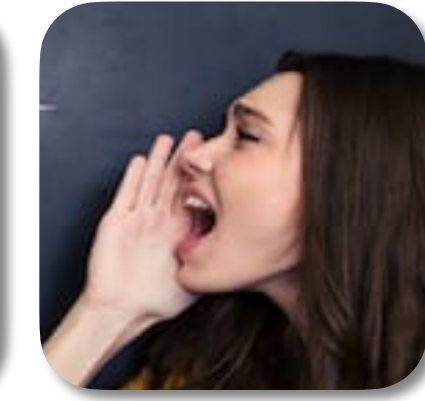
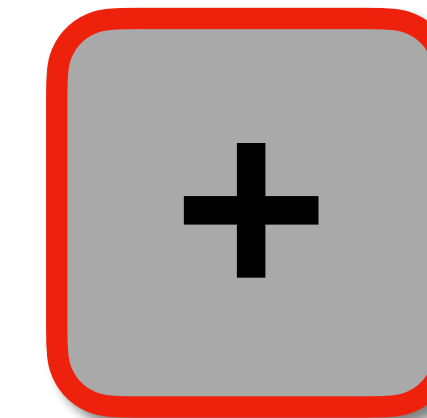
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Basics
Concepts
Metrics
Metric
implementation



Core Traits (3)
Concepts
Baseline implementation
Data collection
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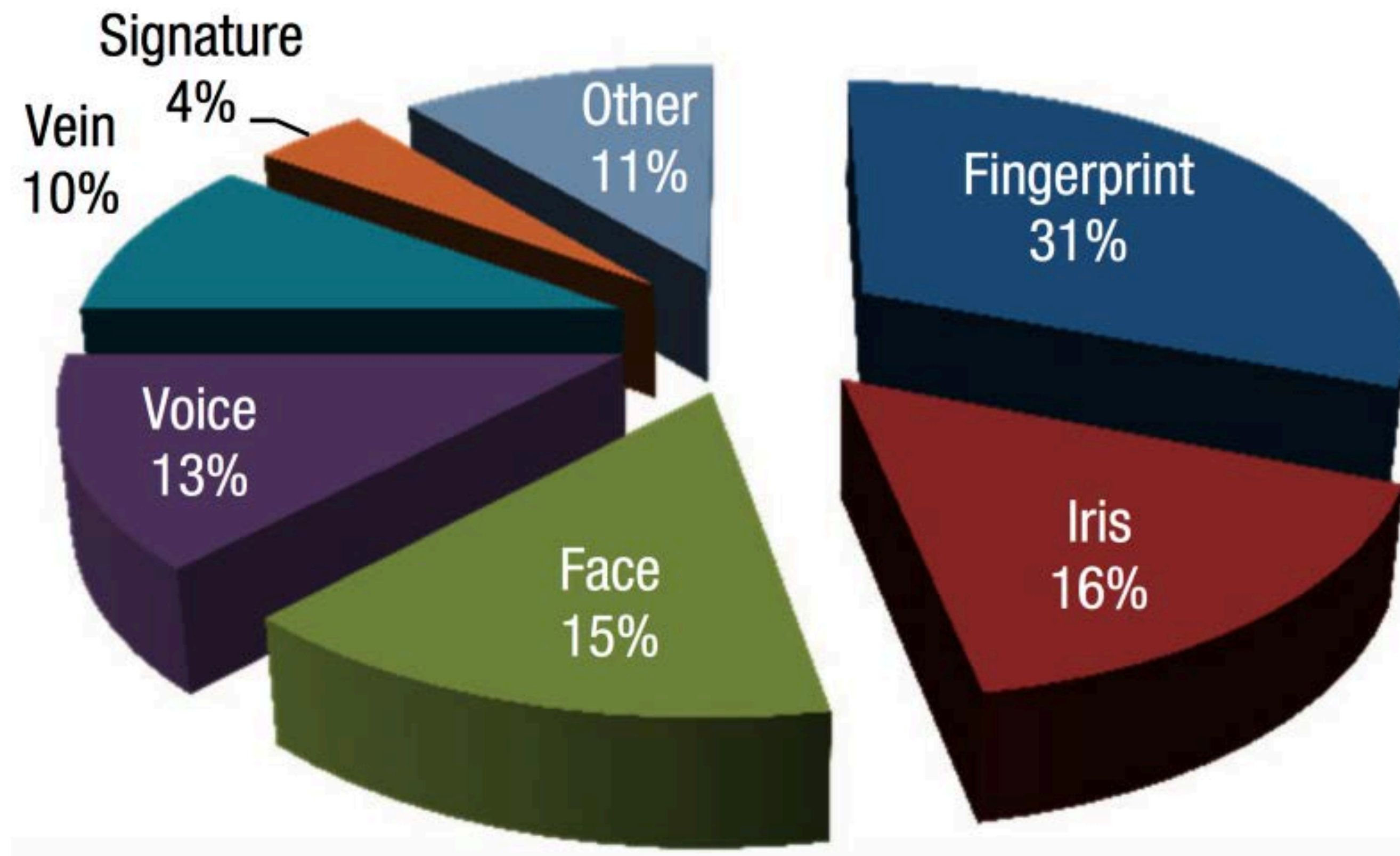
Alternative Traits and Fusion Concepts



Invited Talks (2)
State of the art
Future work

Alternative Traits

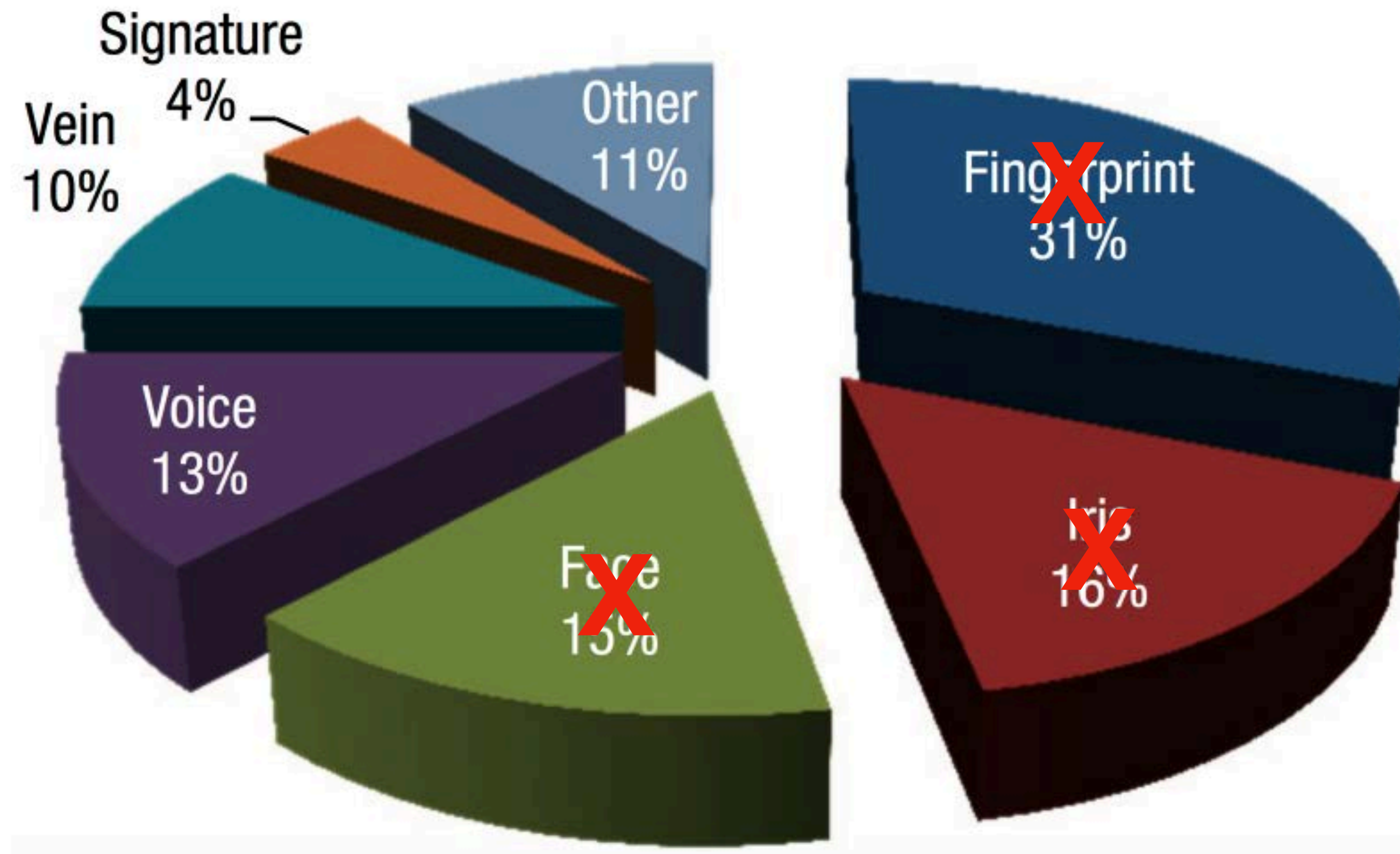
Market



Source: Mani and Nadeski, *Processing solutions for biometric systems*, Texas Instruments, 2015

Alternative Traits

Market



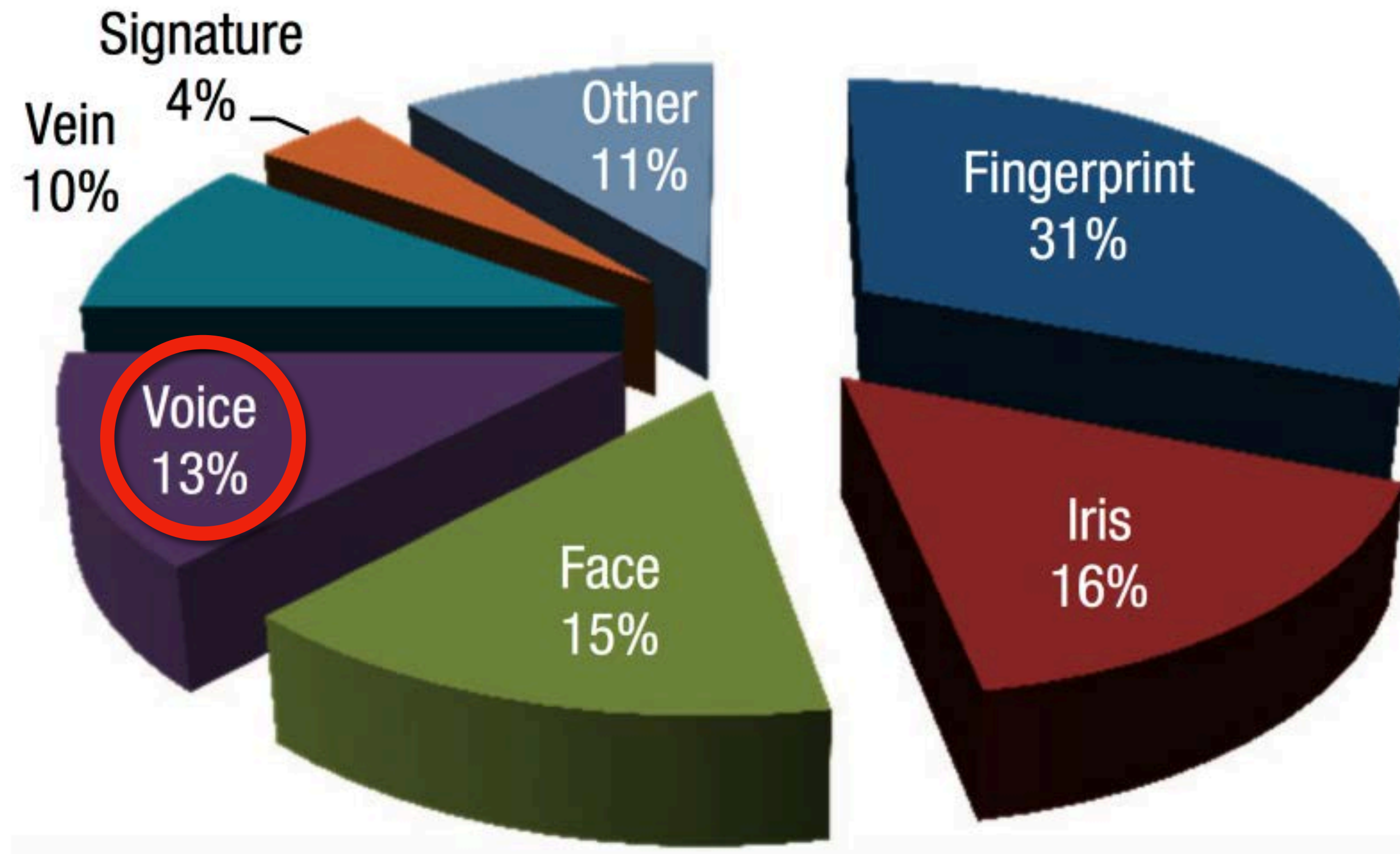
Source: Mani and Nadeski, *Processing solutions for biometric systems*, Texas Instruments, 2015



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Alternative Traits

Market



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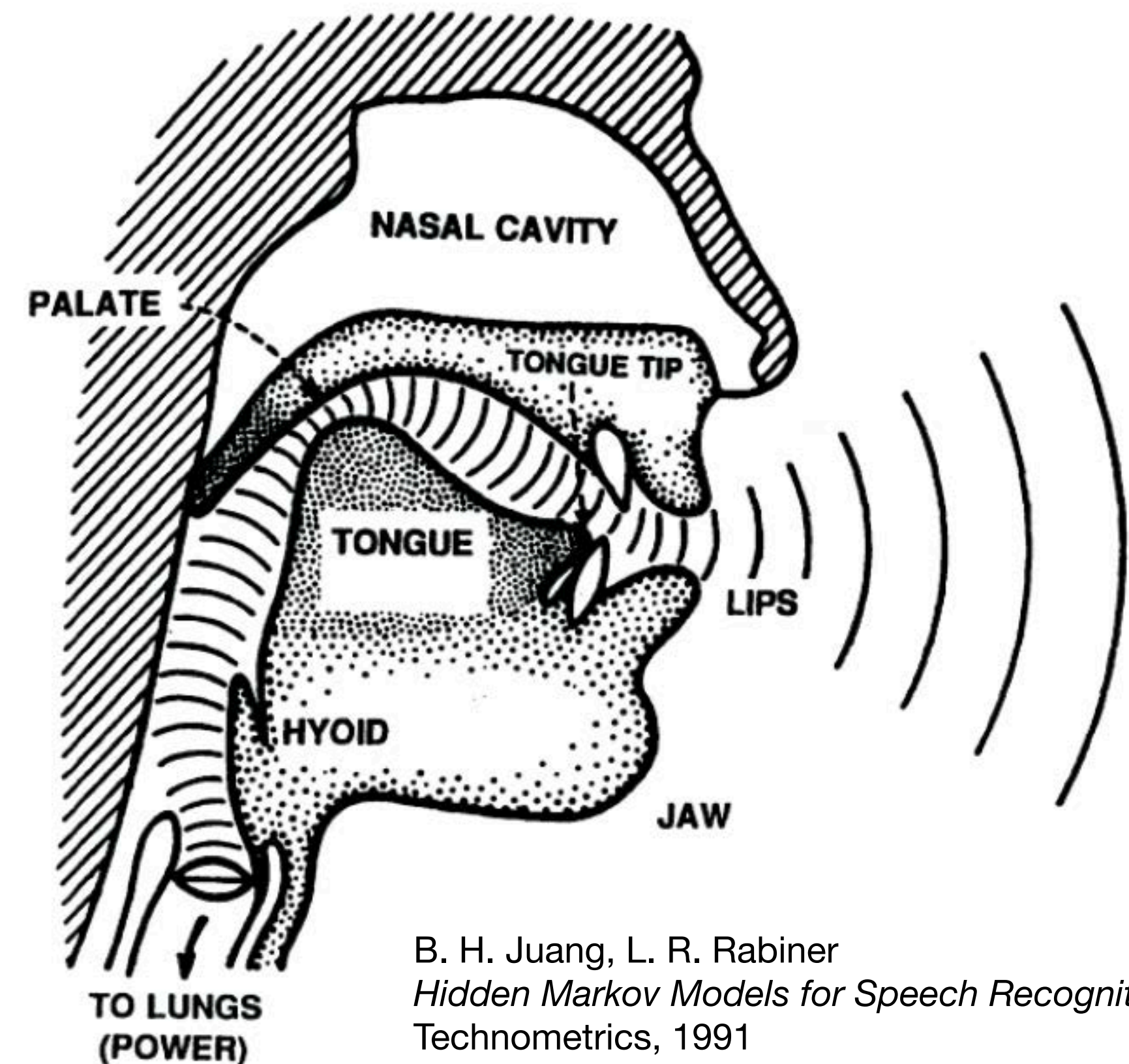
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Voice Recognition

Human Vocal System

Complex combination of organs, rooted on *genetic* factors but mostly *epigenetic*.

Health, age, mood, stress, and even mother tongue will influence somebody's voice.



B. H. Juang, L. R. Rabiner
Hidden Markov Models for Speech Recognition
Technometrics, 1991

Voice Recognition

Acquisition

Off-line

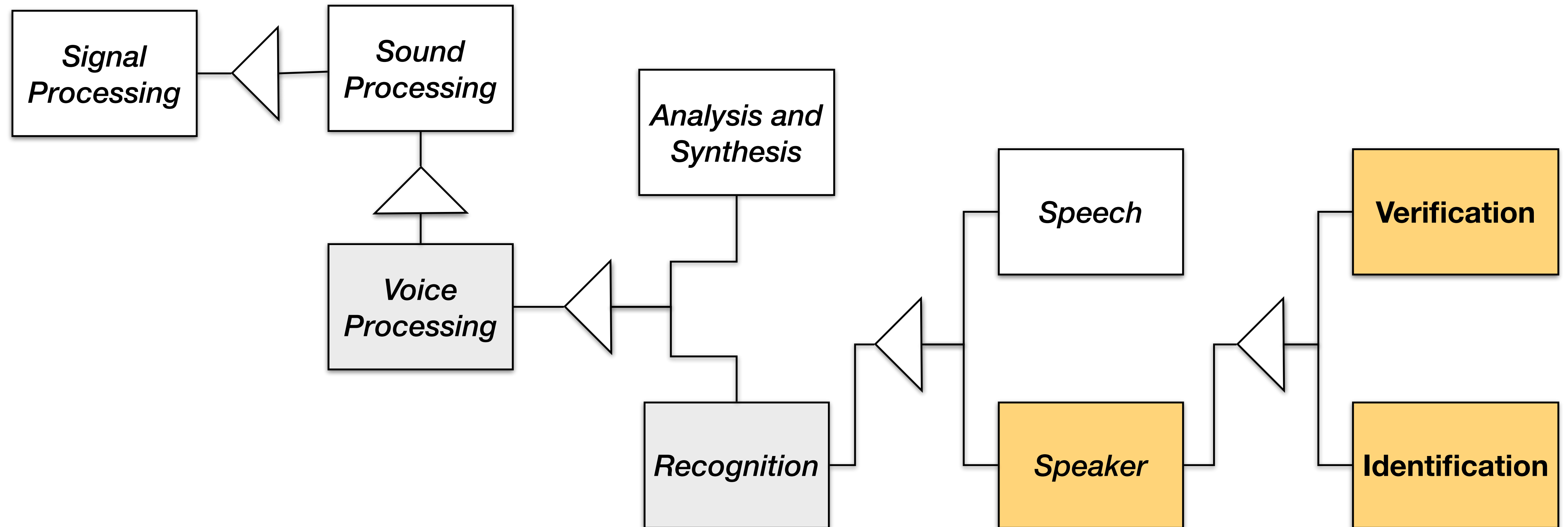


On-line



Voice Recognition

Field Development



Voice Recognition

Variants



Fixed-Text

Enrollment and authentication with the same word.

Text-Dependent

Usage of authentication phrases (composed from a pre-defined vocabulary).

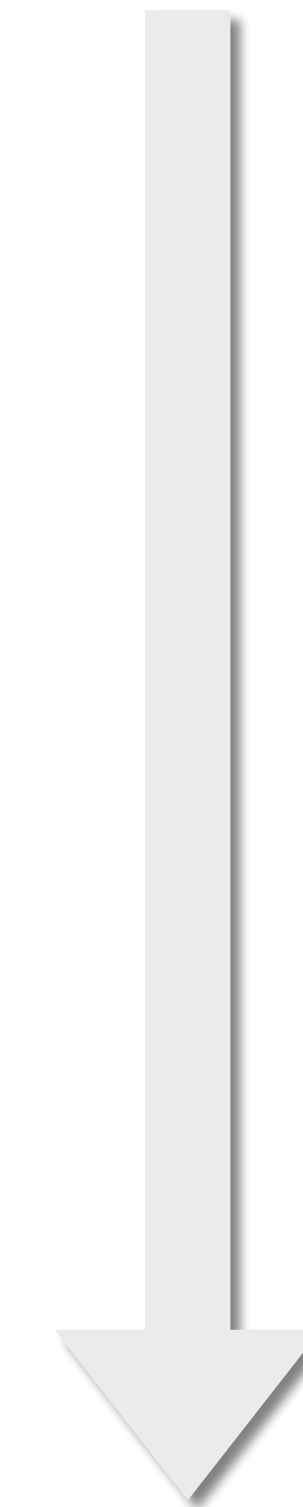
Text-Independent

Users may say any word/phrase.

Conversational (under development)

Speech and speaker recognition, with semantic analysis.

Security



increases



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Voice Recognition

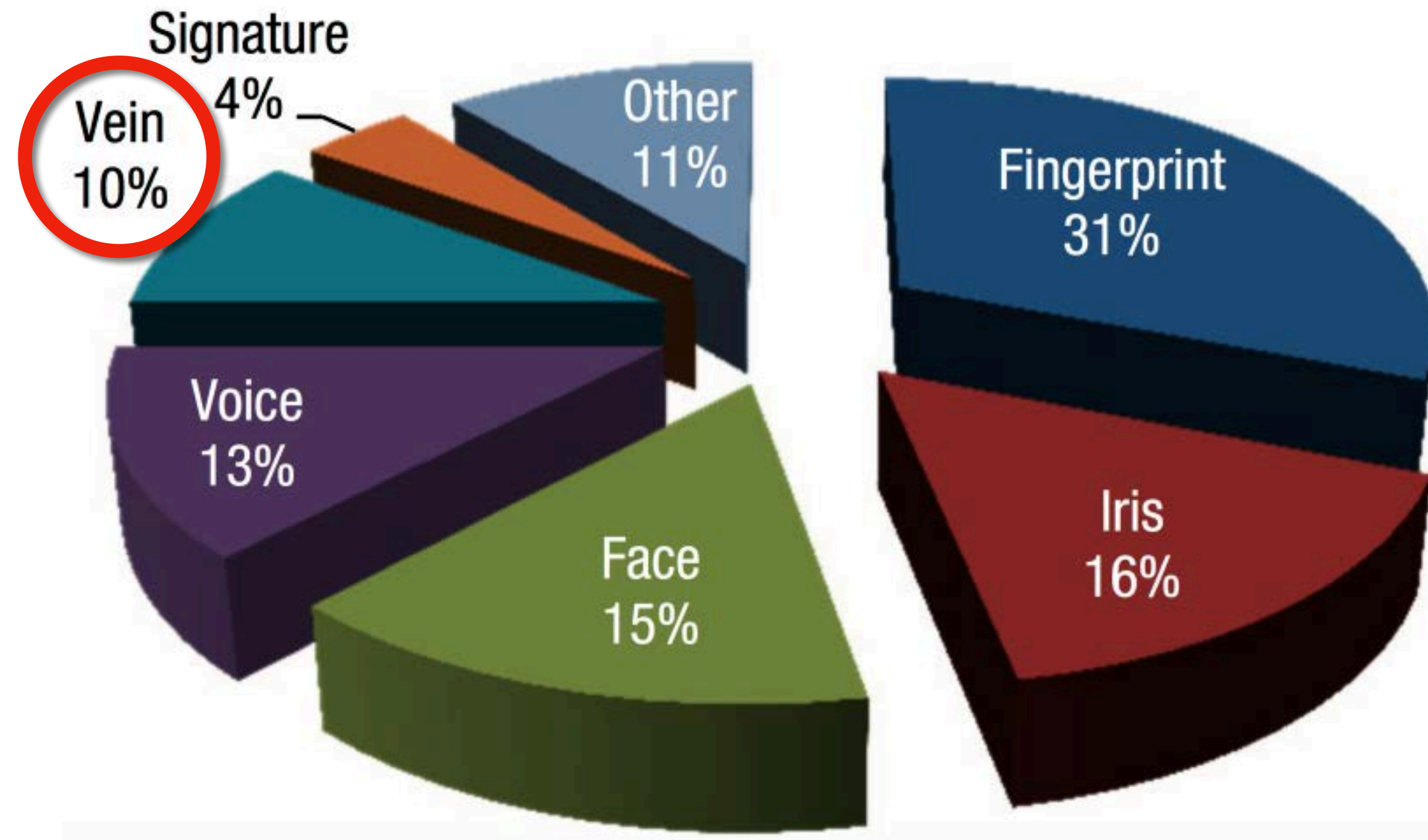
A New Era of Presentation Attack

[https://www.youtube.com/
watch?v=DWK_iYBI8cA](https://www.youtube.com/watch?v=DWK_iYBI8cA)

The following audio clips are
not real, they were generated
by a machine learning model.

Alternative Traits

Market



Source: Mani and Nadeski, *Processing solutions for biometric systems*, Texas Instruments, 2015



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Vein Recognition

Human Circulatory System

Veins are *epigenetic*.

Commonest modalities:
palm and finger veins.



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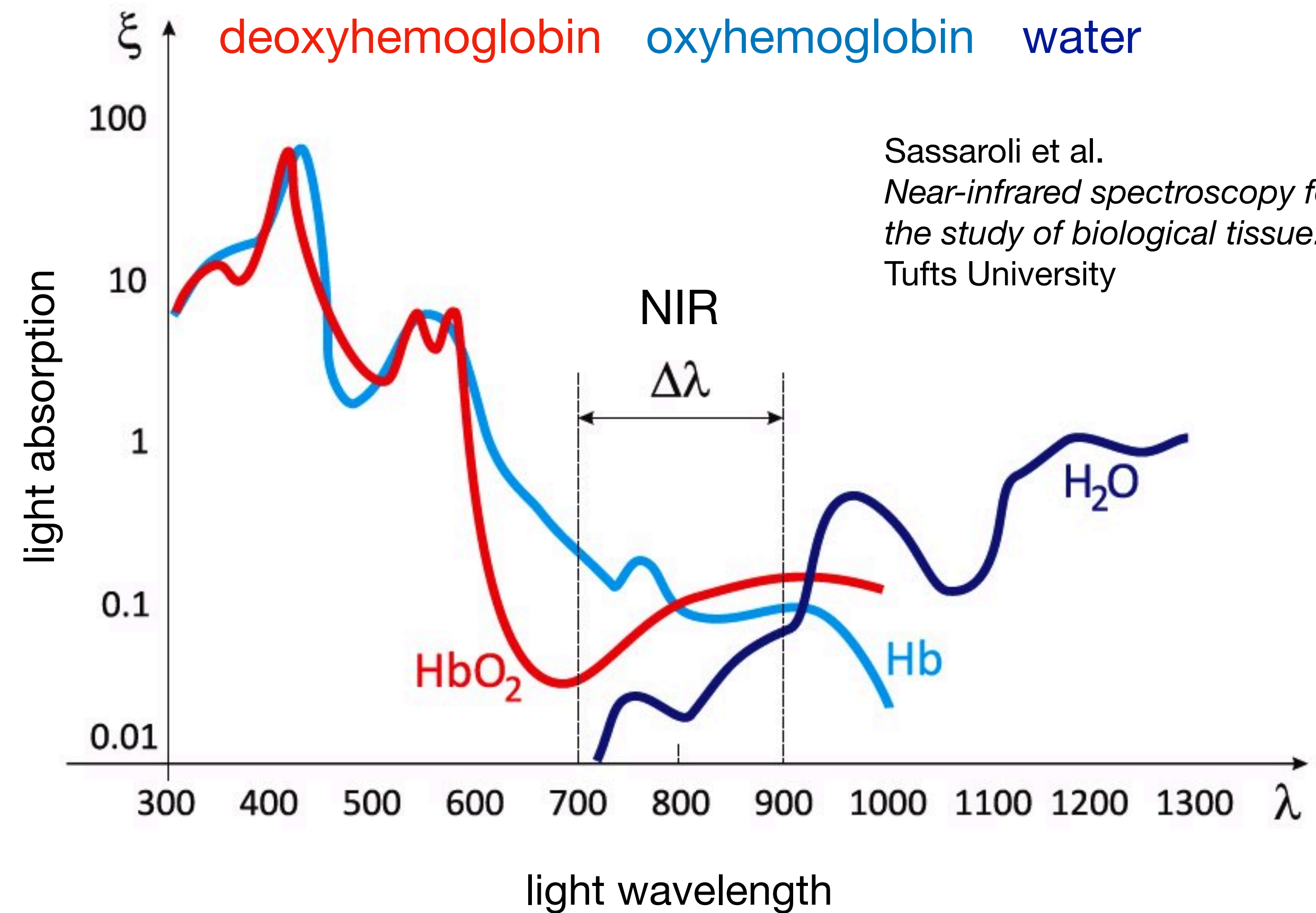


Hitachi
Finger Vein Authentication
White Paper, 2004

Vein Recognition

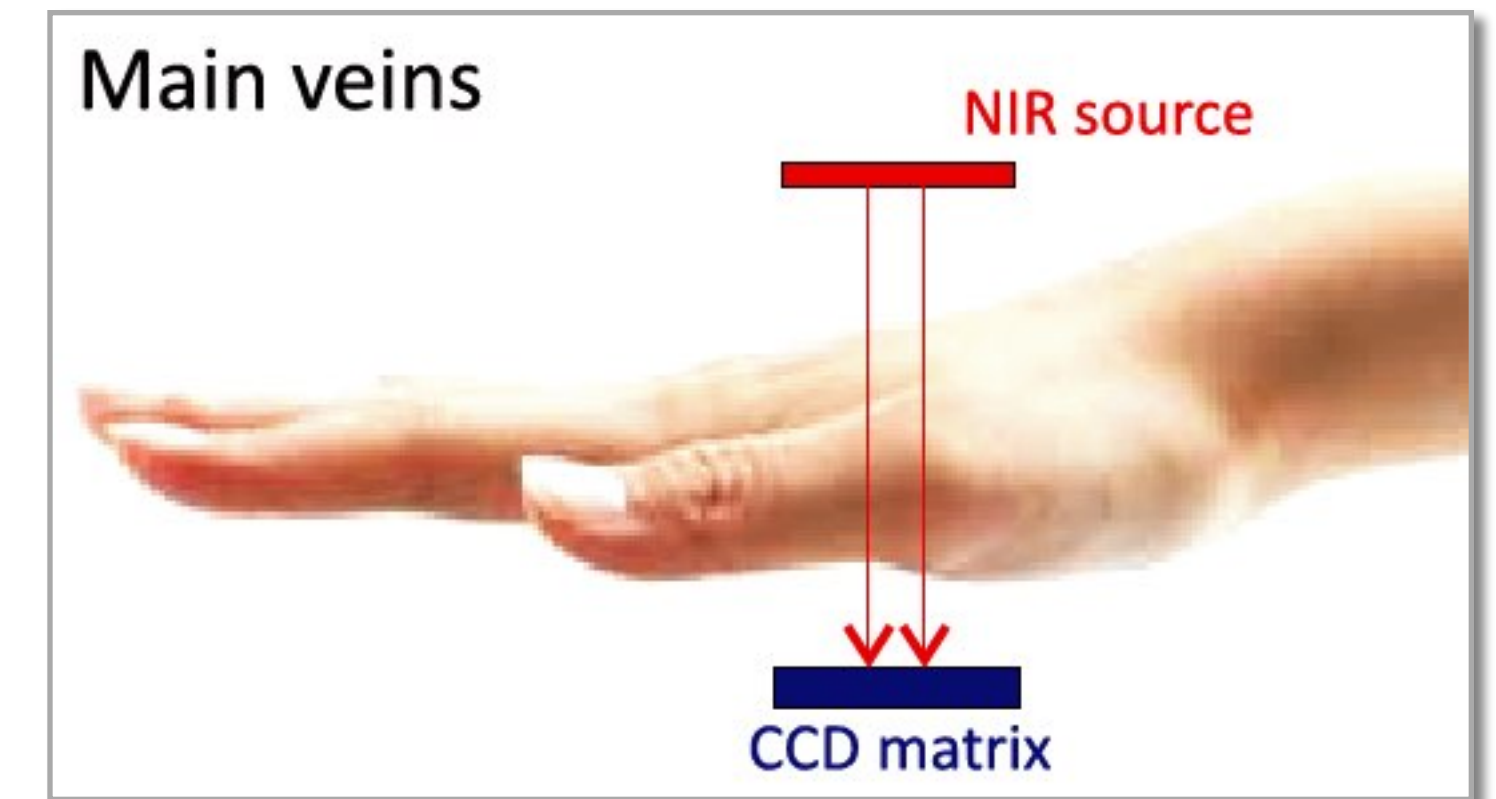
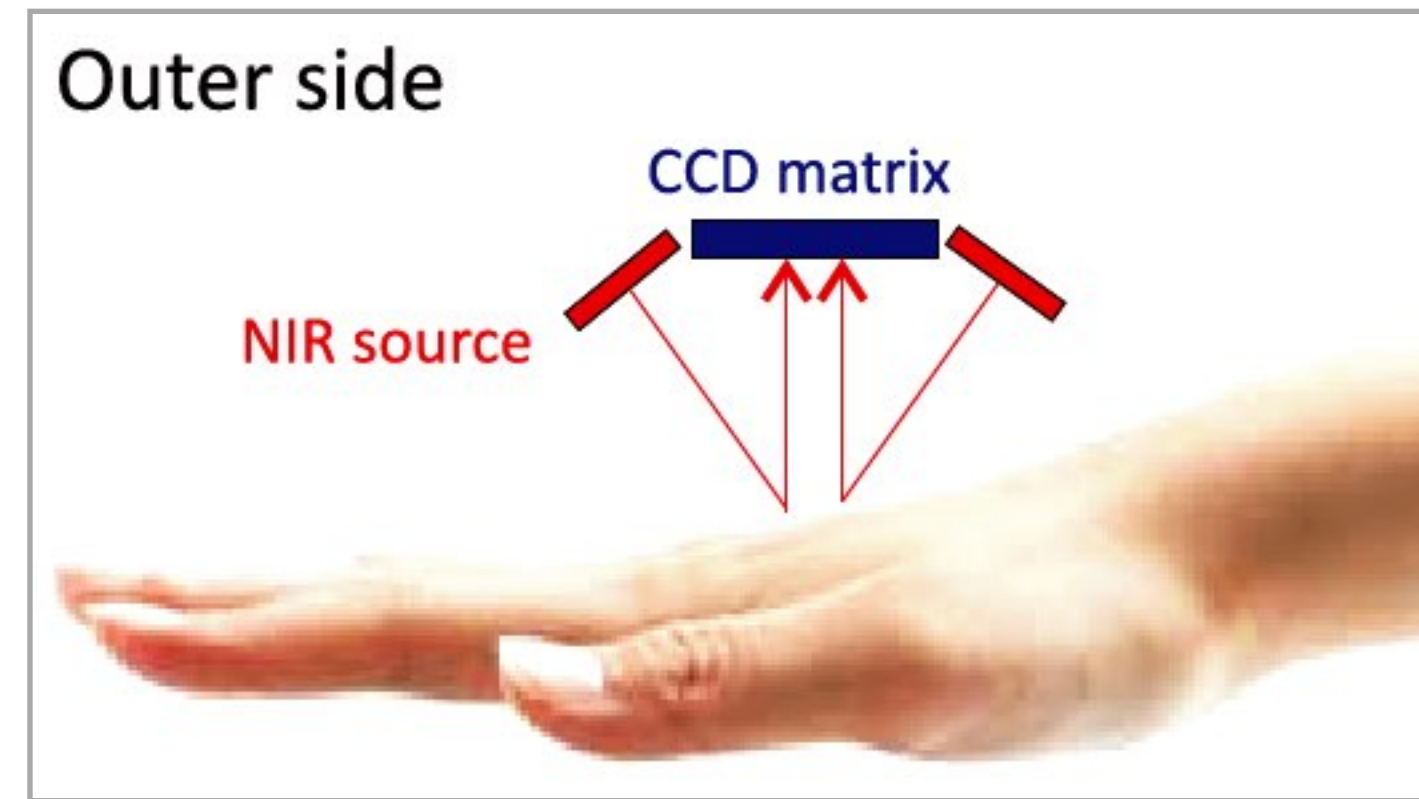
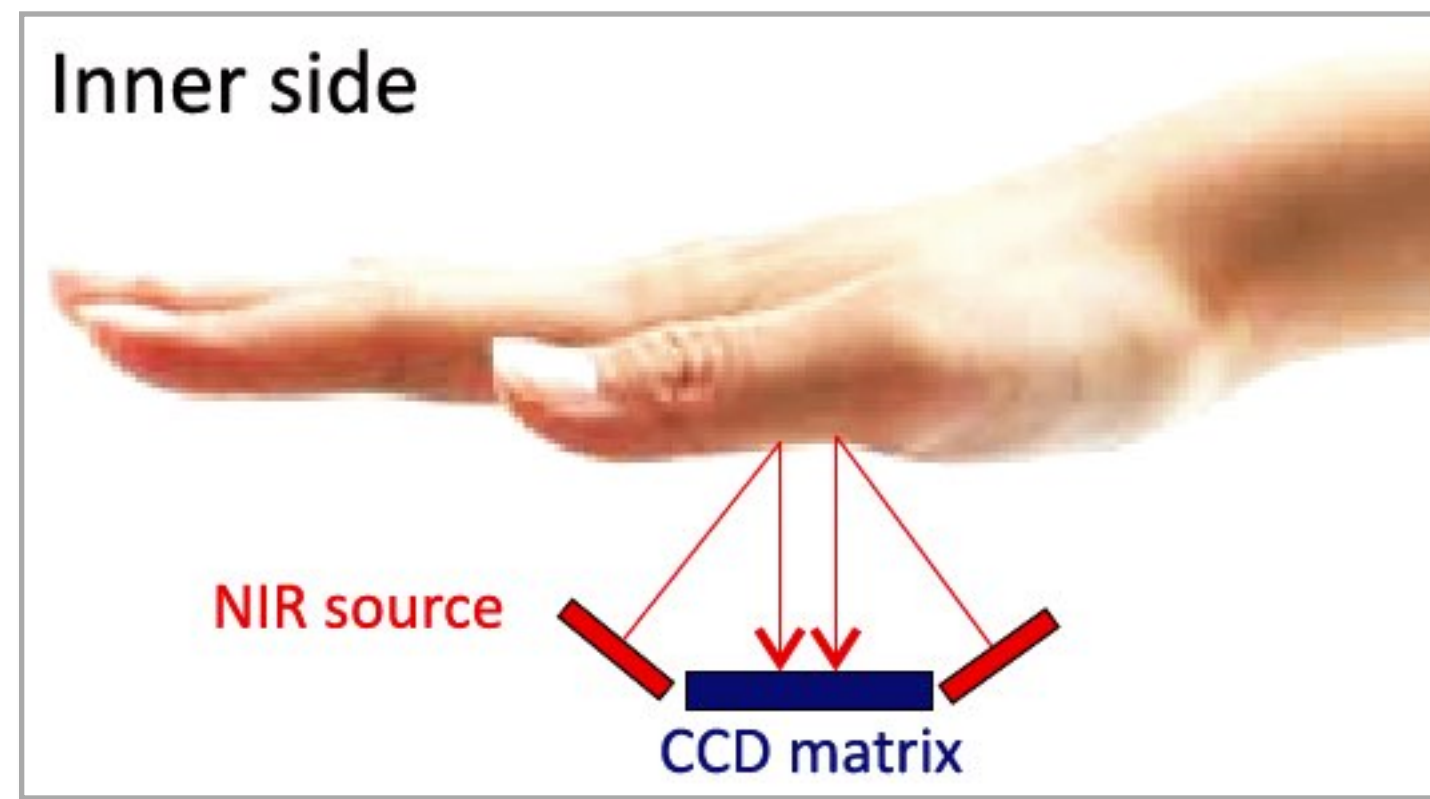
Acquisition

Dedicated near-infrared (NIR) light sensors (on-line acquisition).



Vein Recognition

Palm Vein Acquisition



Dr. Adam Czajka

Vein Recognition

Palm Vein Acquisition

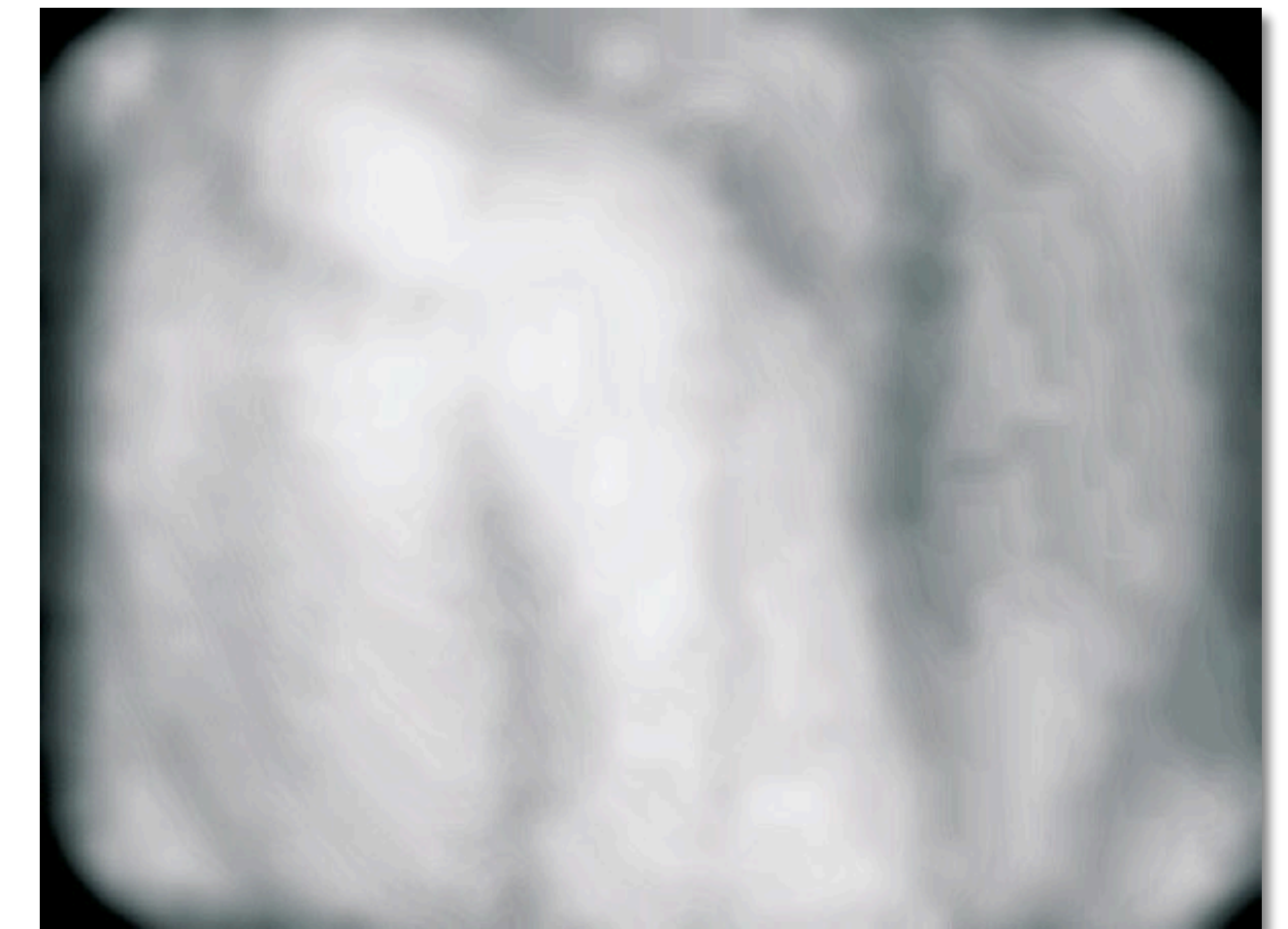
MITRE
State of the Art Biometrics Excellence Roadmap
Tech. Report, 2008



Fujitsu PalmSecure reader

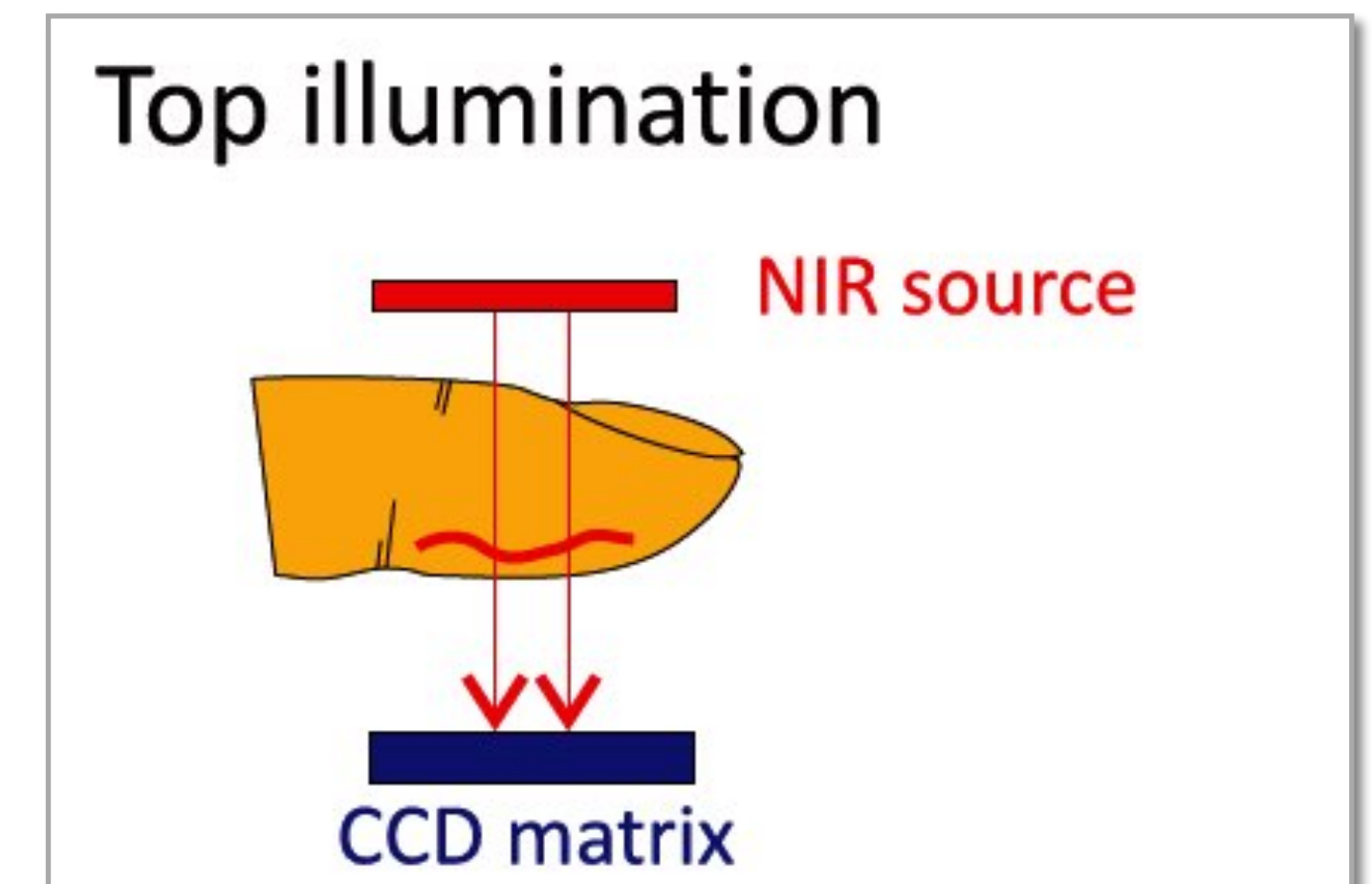
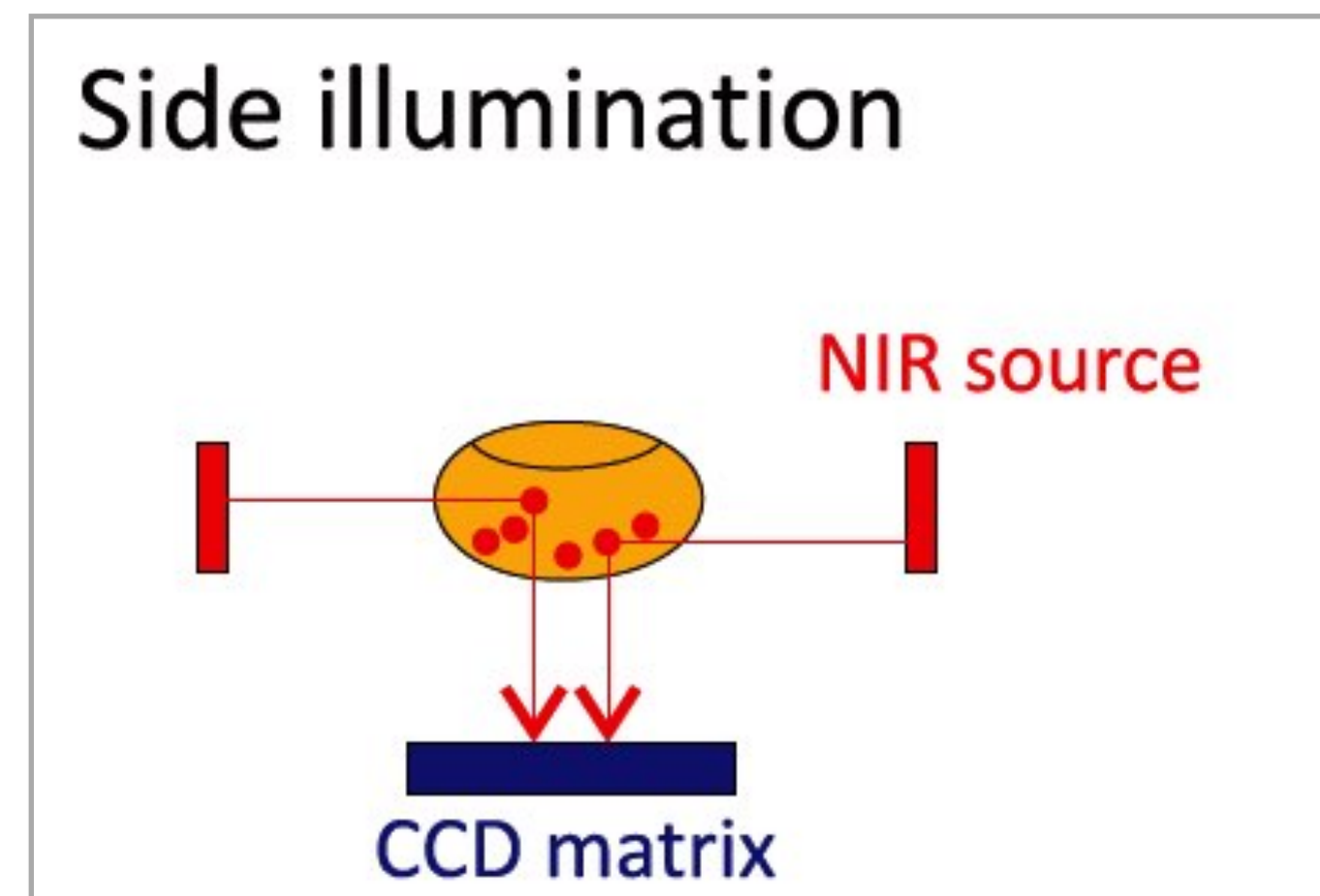
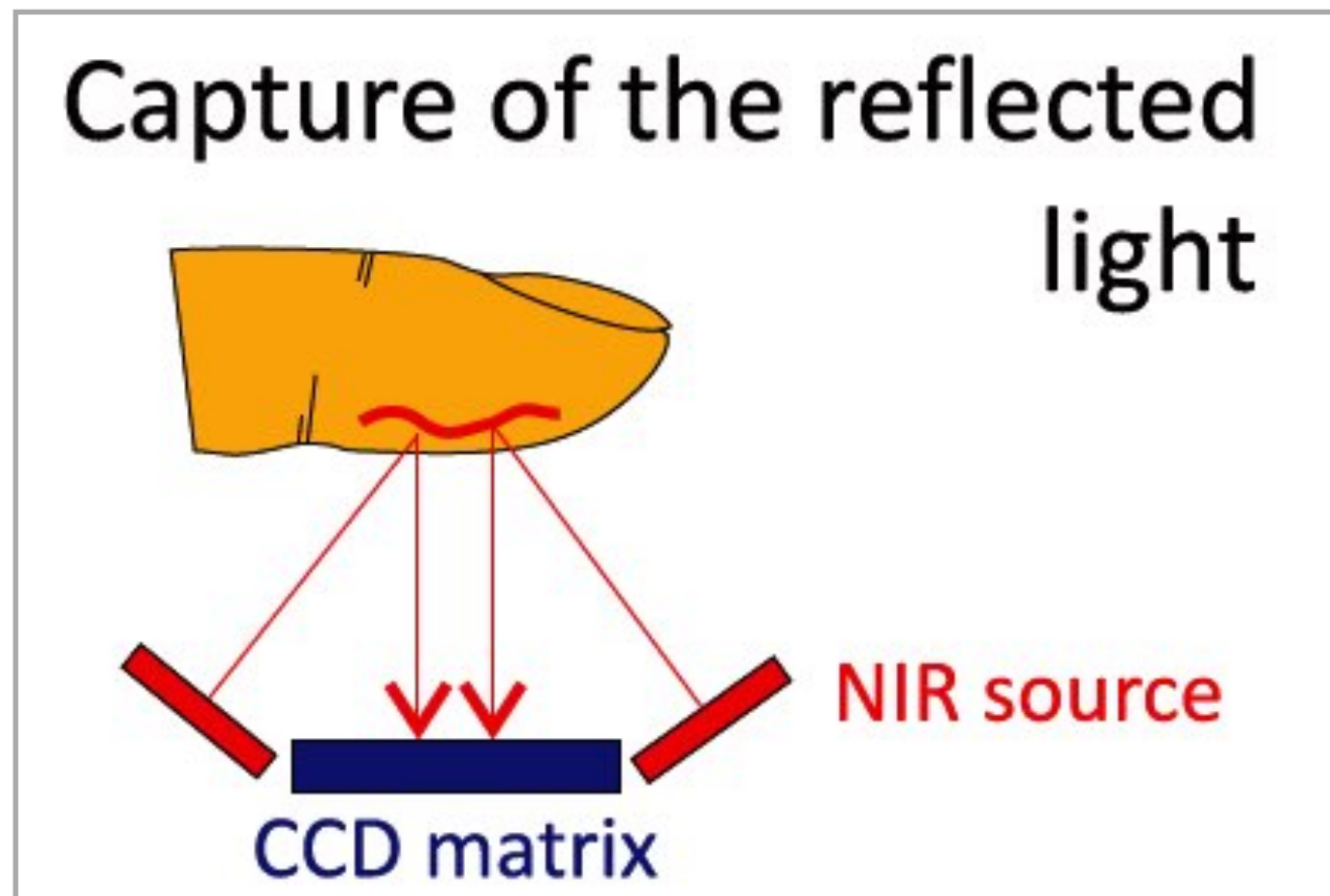


Techsphere VP II reader



Vein Recognition

Finger Vein Acquisition



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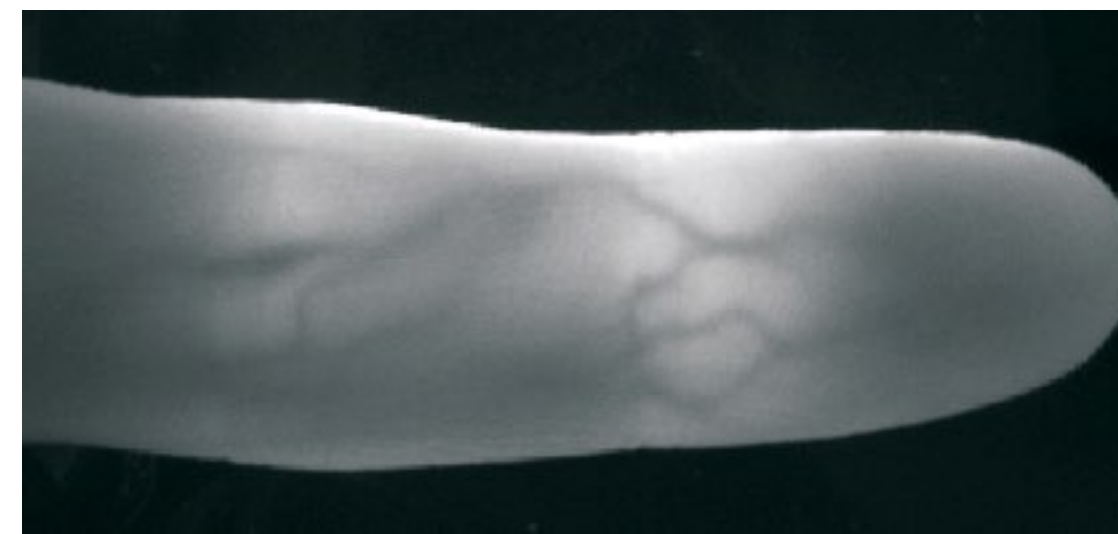
Vein Recognition

Finger Vein Acquisition



Hitachi H1 reader
(with top illumination)

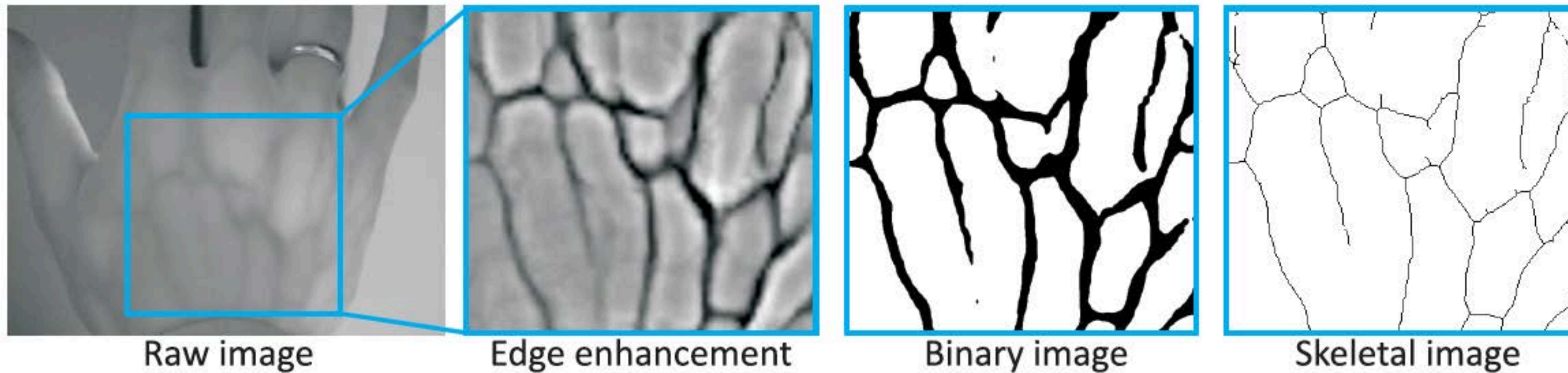
MITRE
State of the Art Biometrics Excellence Roadmap
Tech. Report, 2008



Vein Recognition

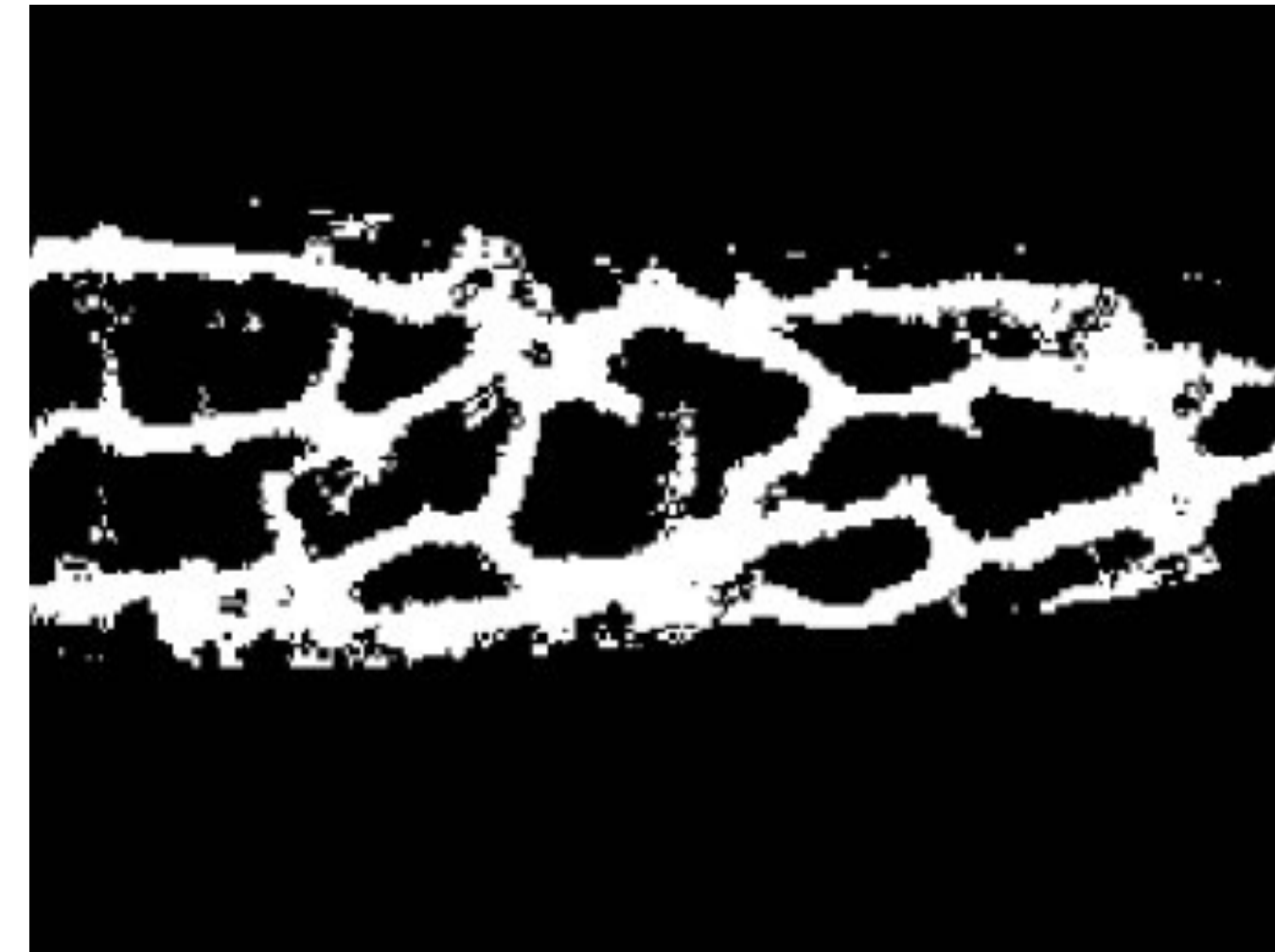
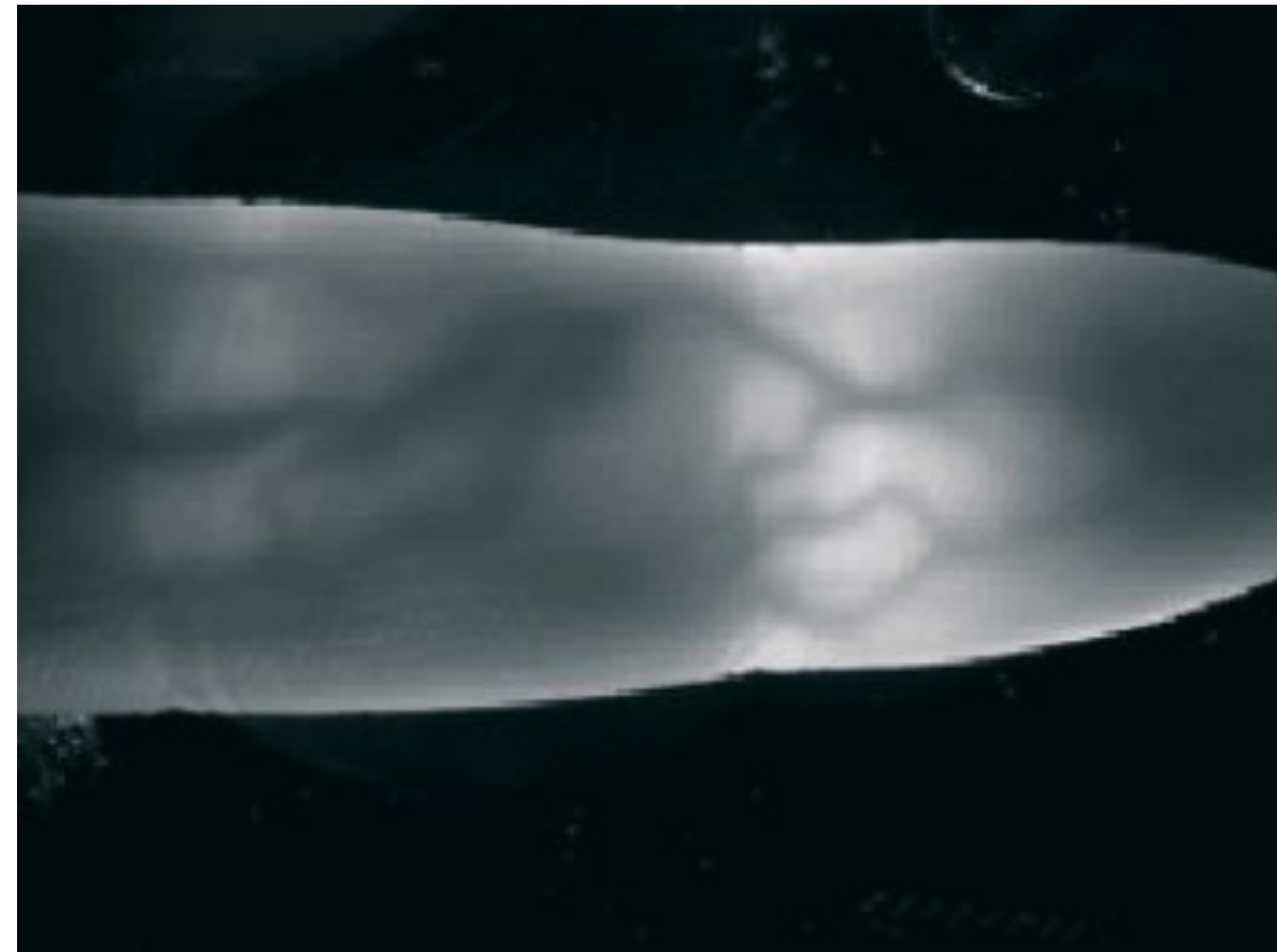
Vein Description Strategies

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Vein Recognition

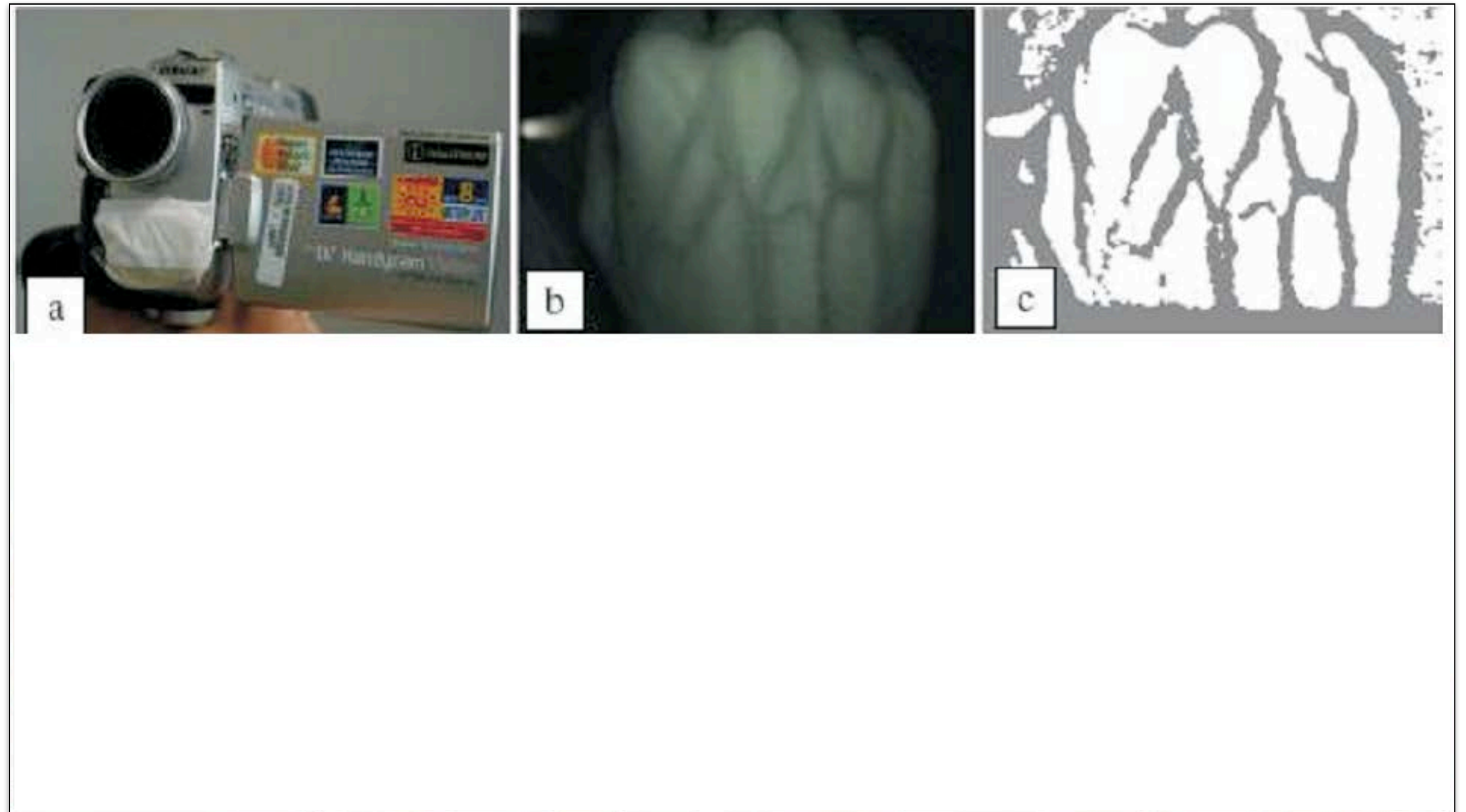
Vein Description Strategies



Miura et al.
Extraction of Ginger-Vein Patterns Using Maximum Curvature Points in Image Profiles
IAPR 2005

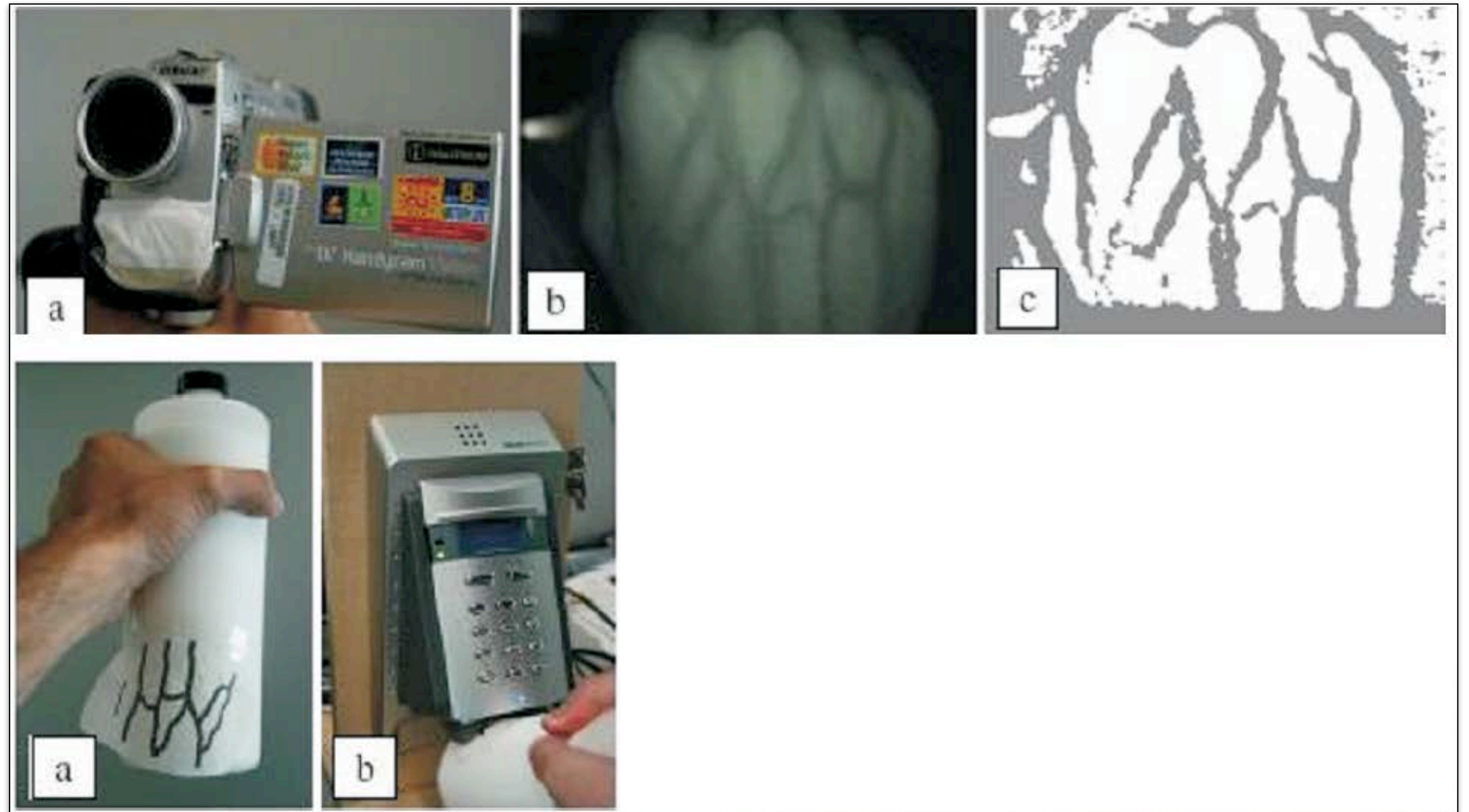
Vein Recognition

Presentation Attack



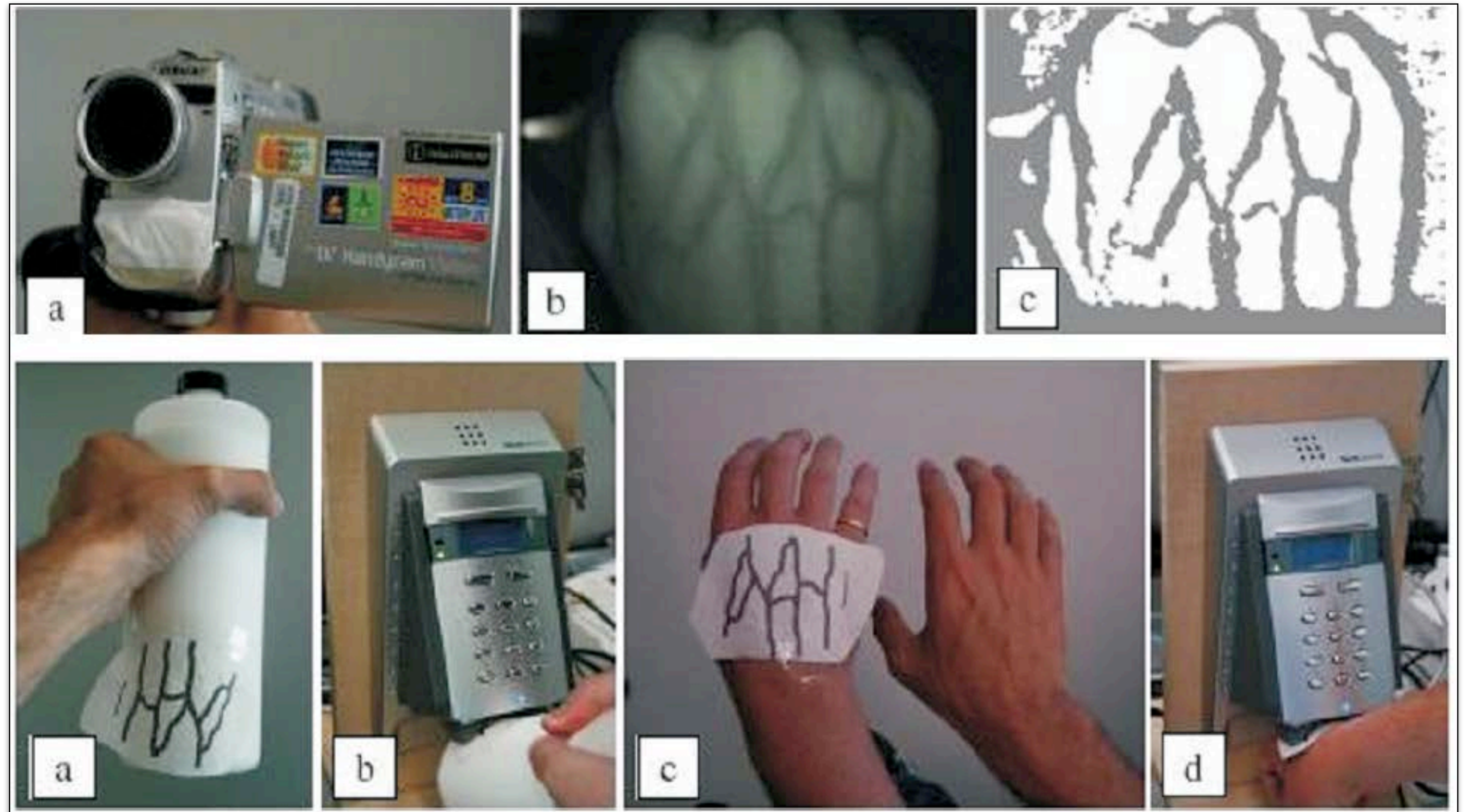
Vein Recognition

Presentation Attack



Vein Recognition

Presentation Attack



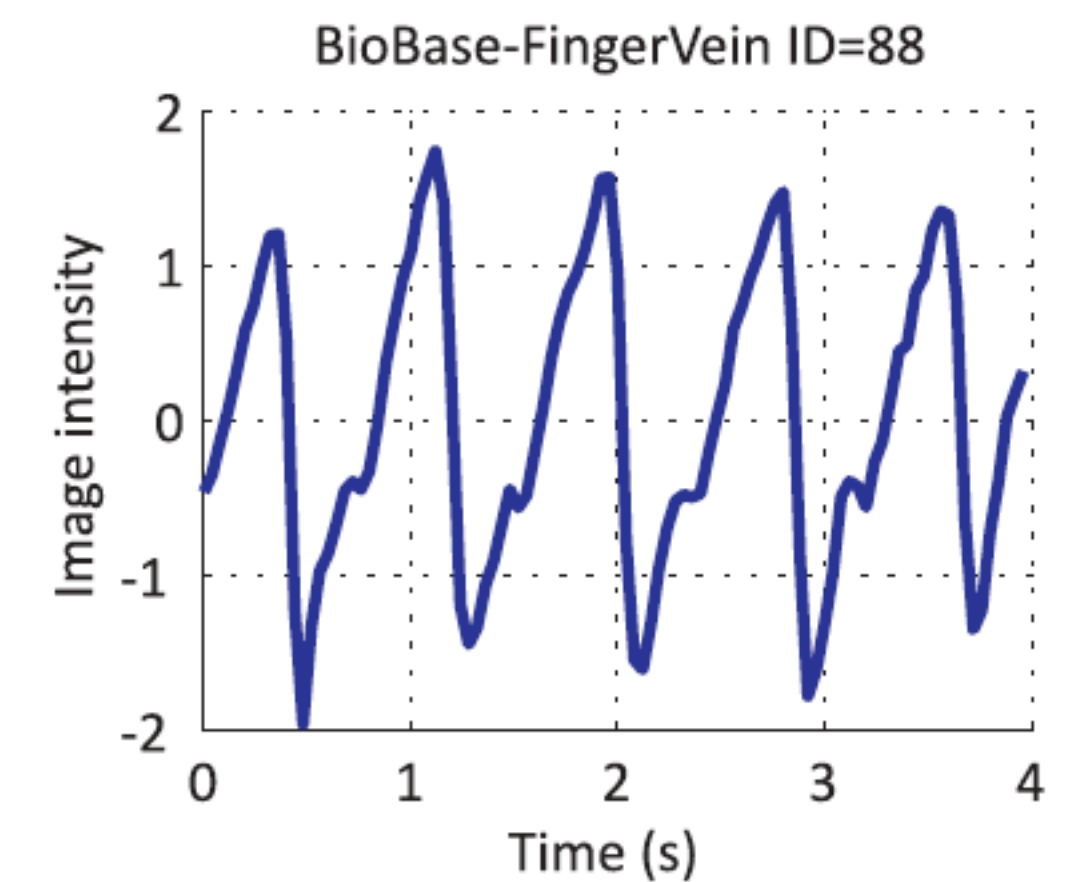
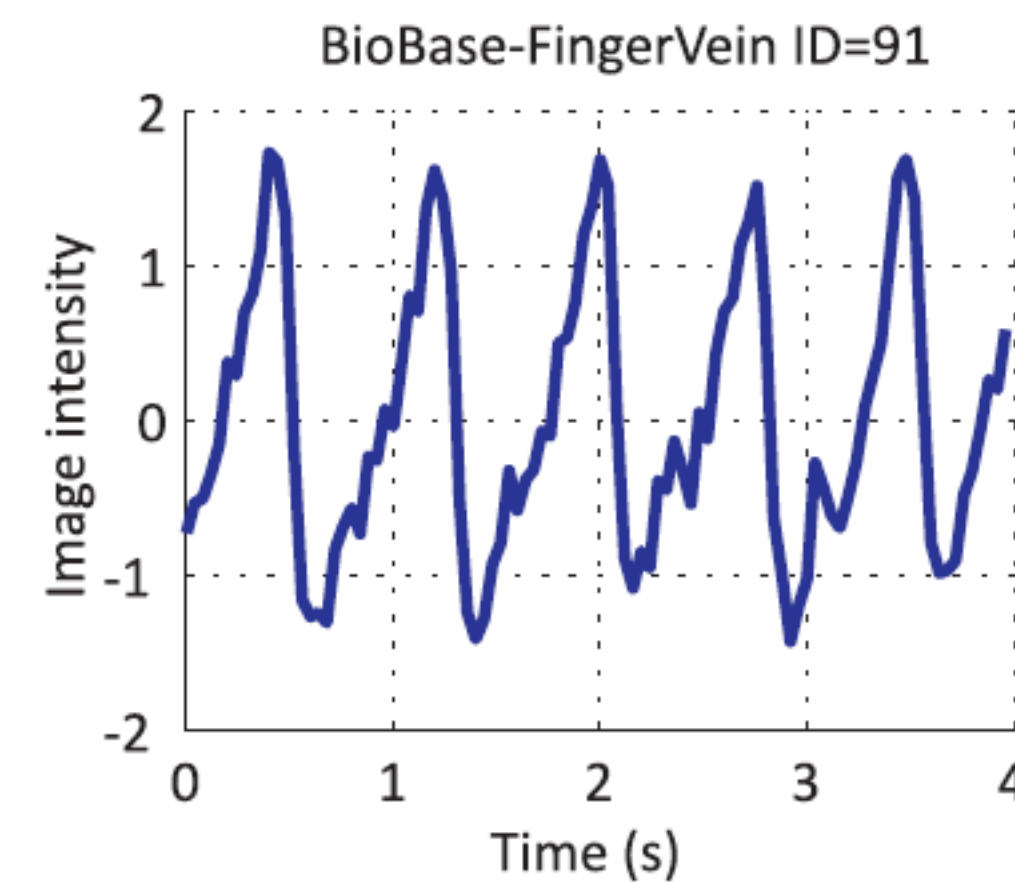
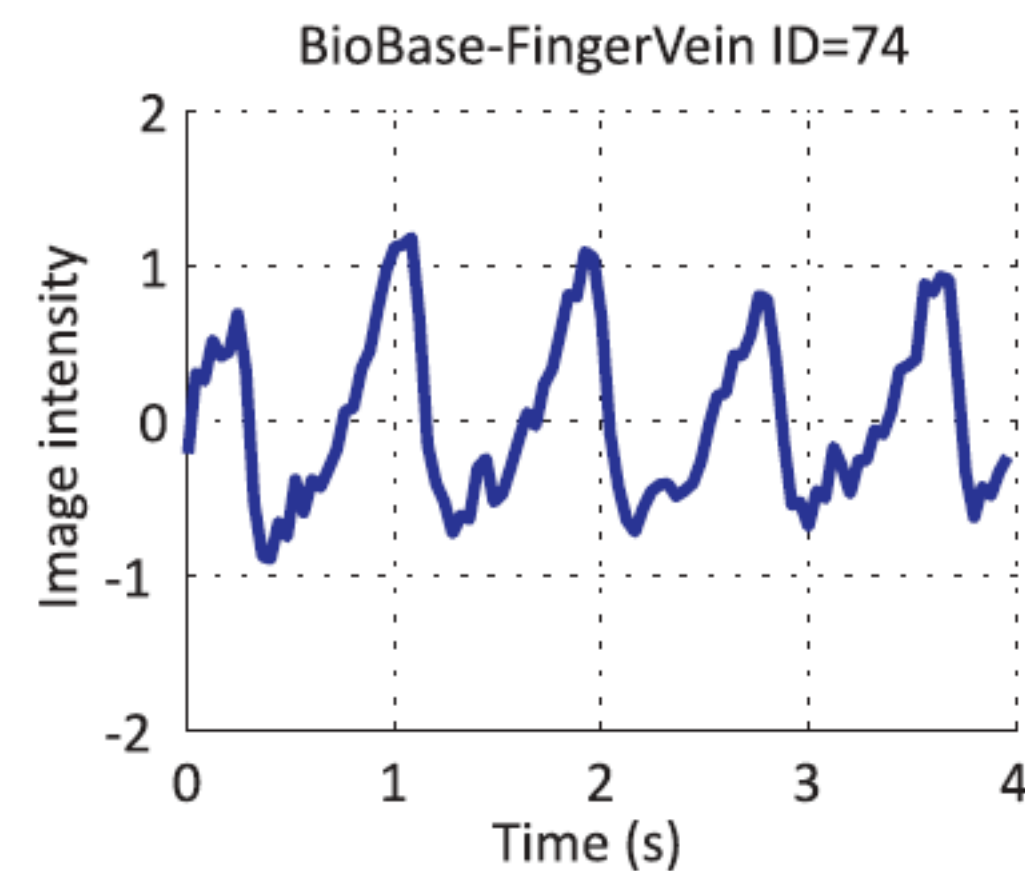
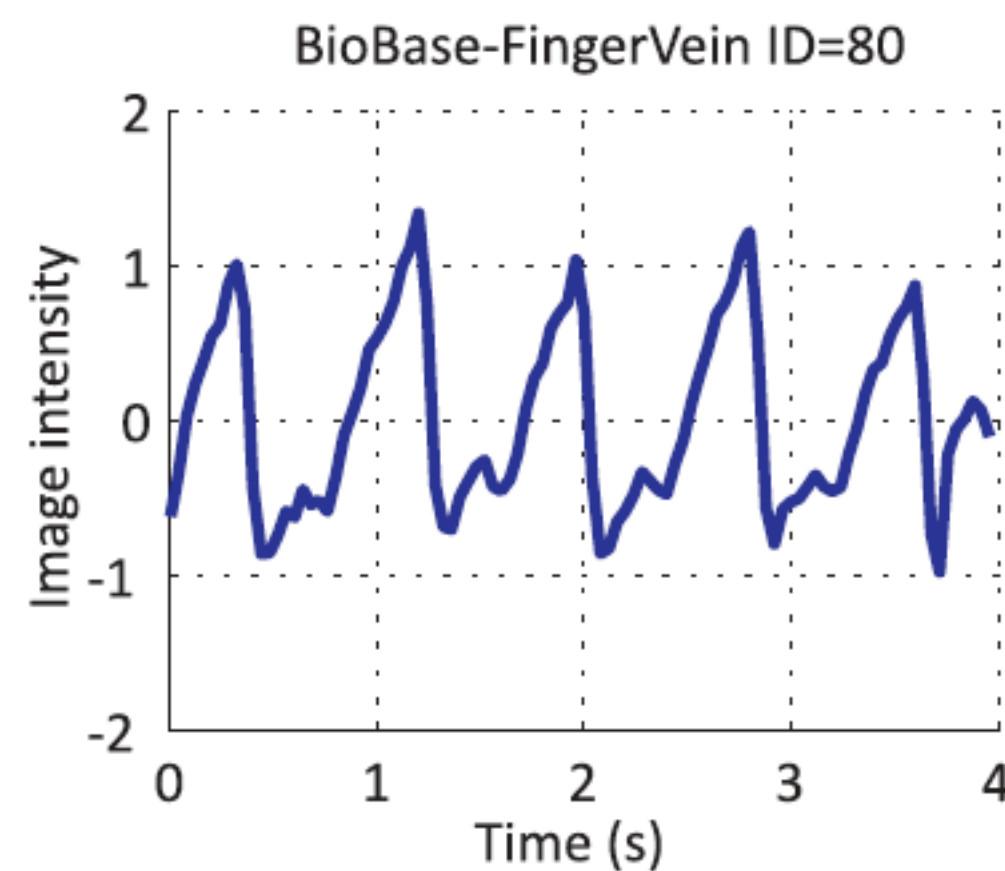
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*State of the Art Biometrics
Excellence Roadmap*
Tech. Report, 2008

Vein Recognition

Presentation Attack Detection

Blood Pulse Detection

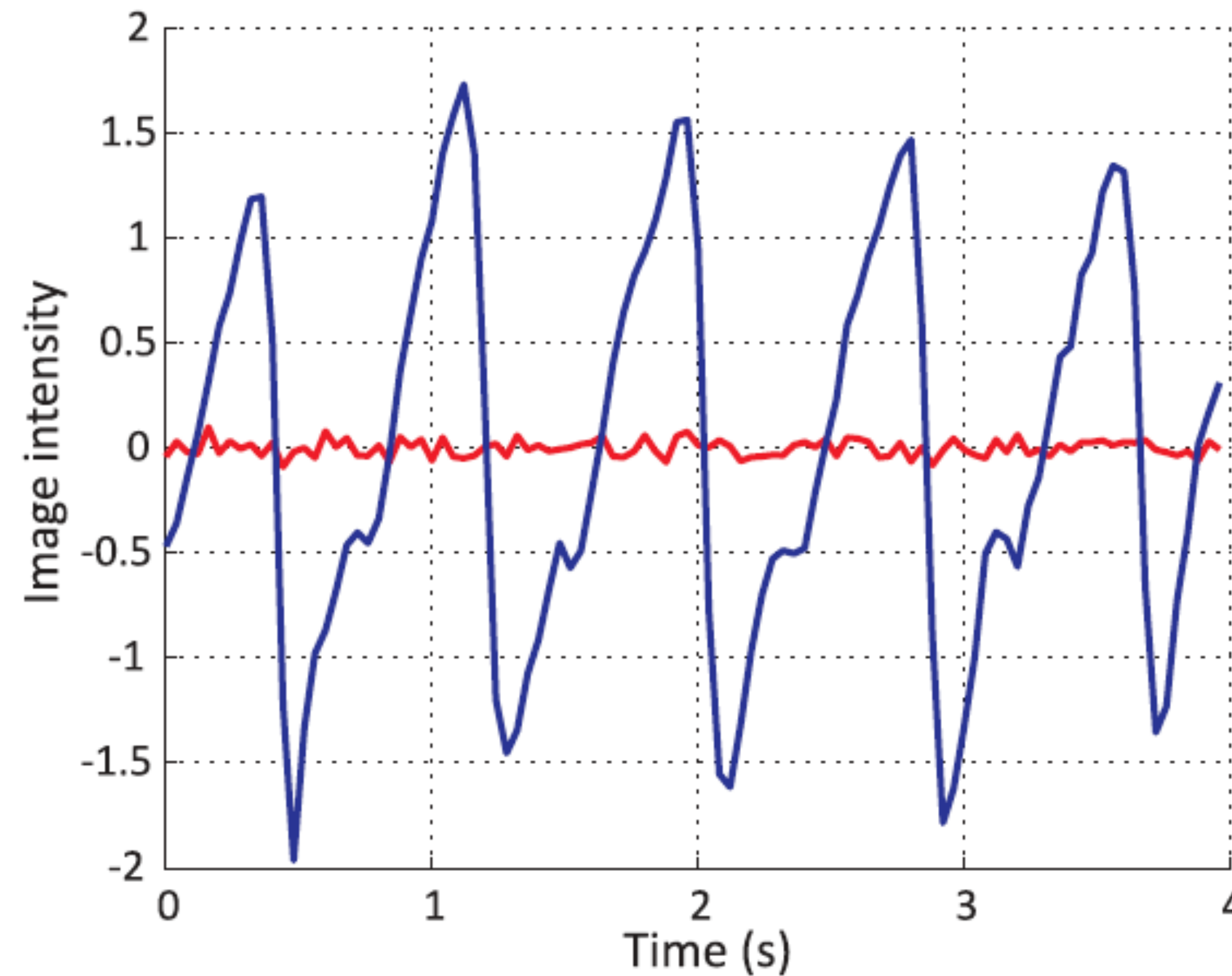
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Vein Recognition

Presentation Attack Detection

Blood Pulse Detection



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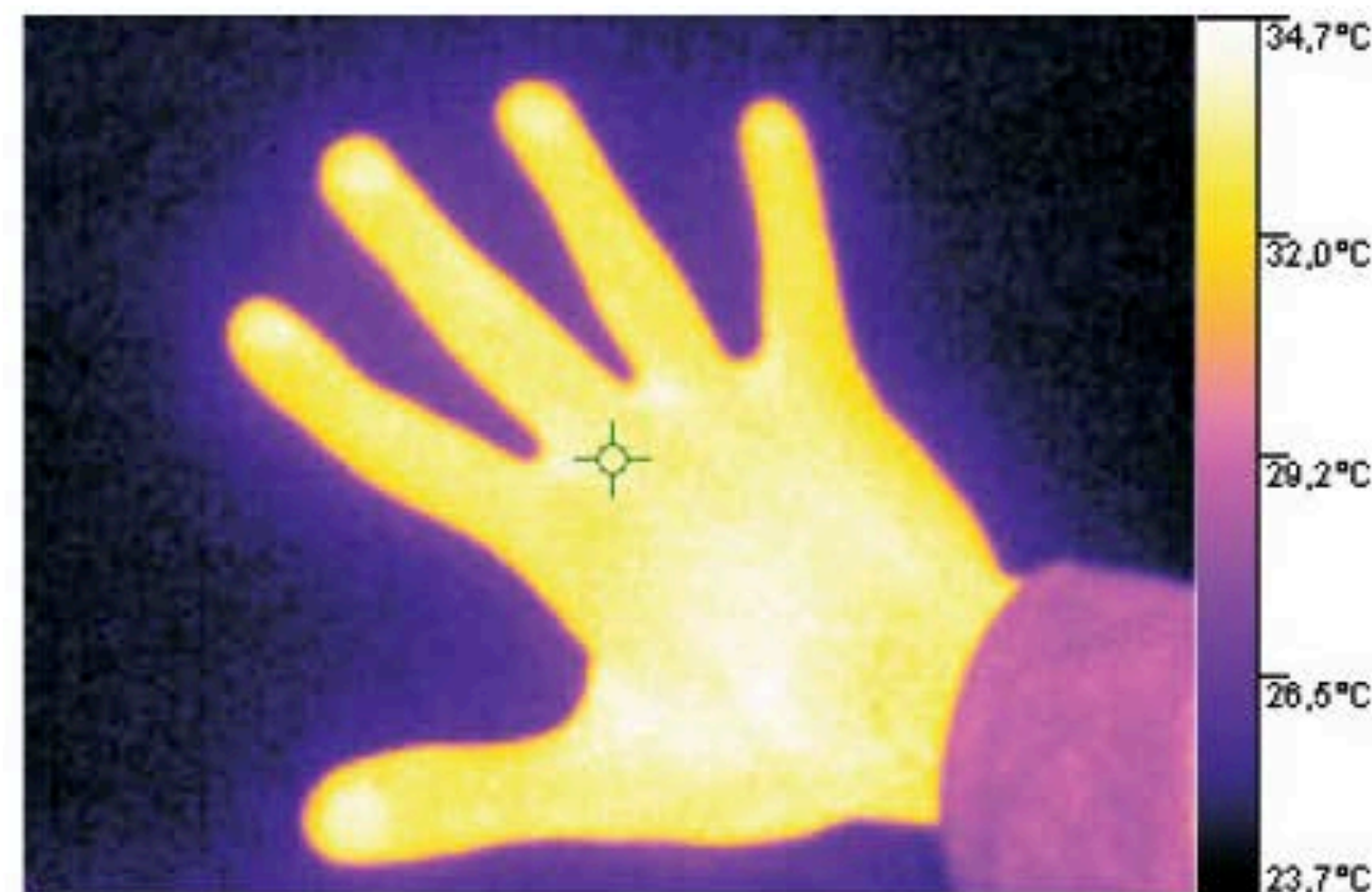
■ Forgery

Vein Recognition

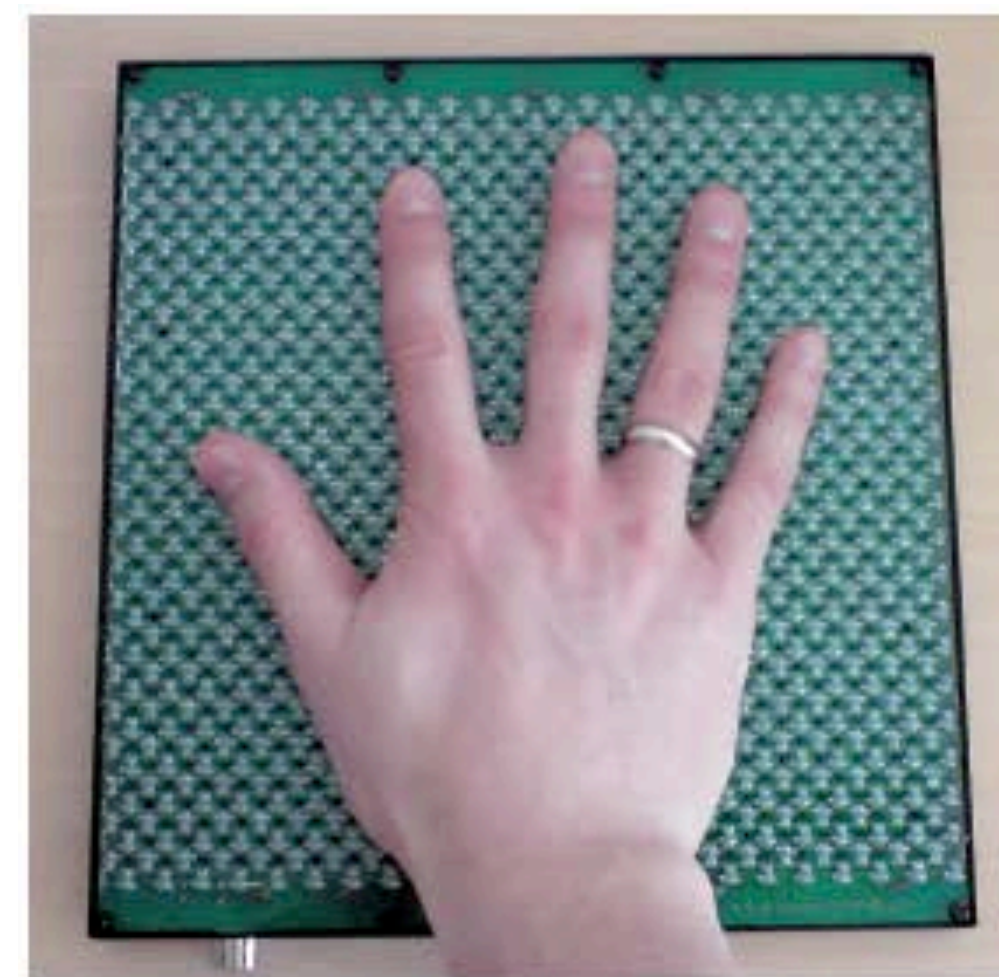
Presentation Attack Detection

Temperature Measurement

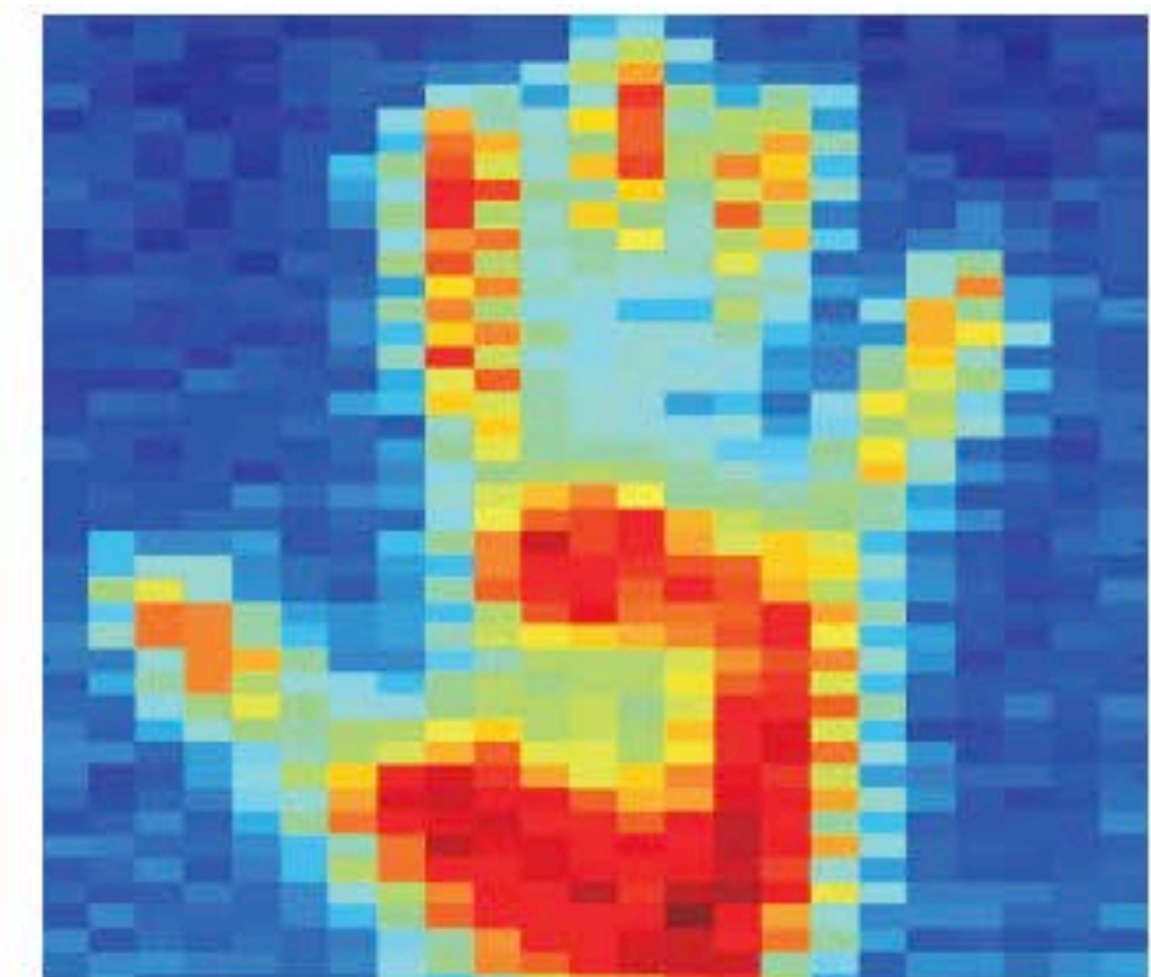
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Raw thermal camera image



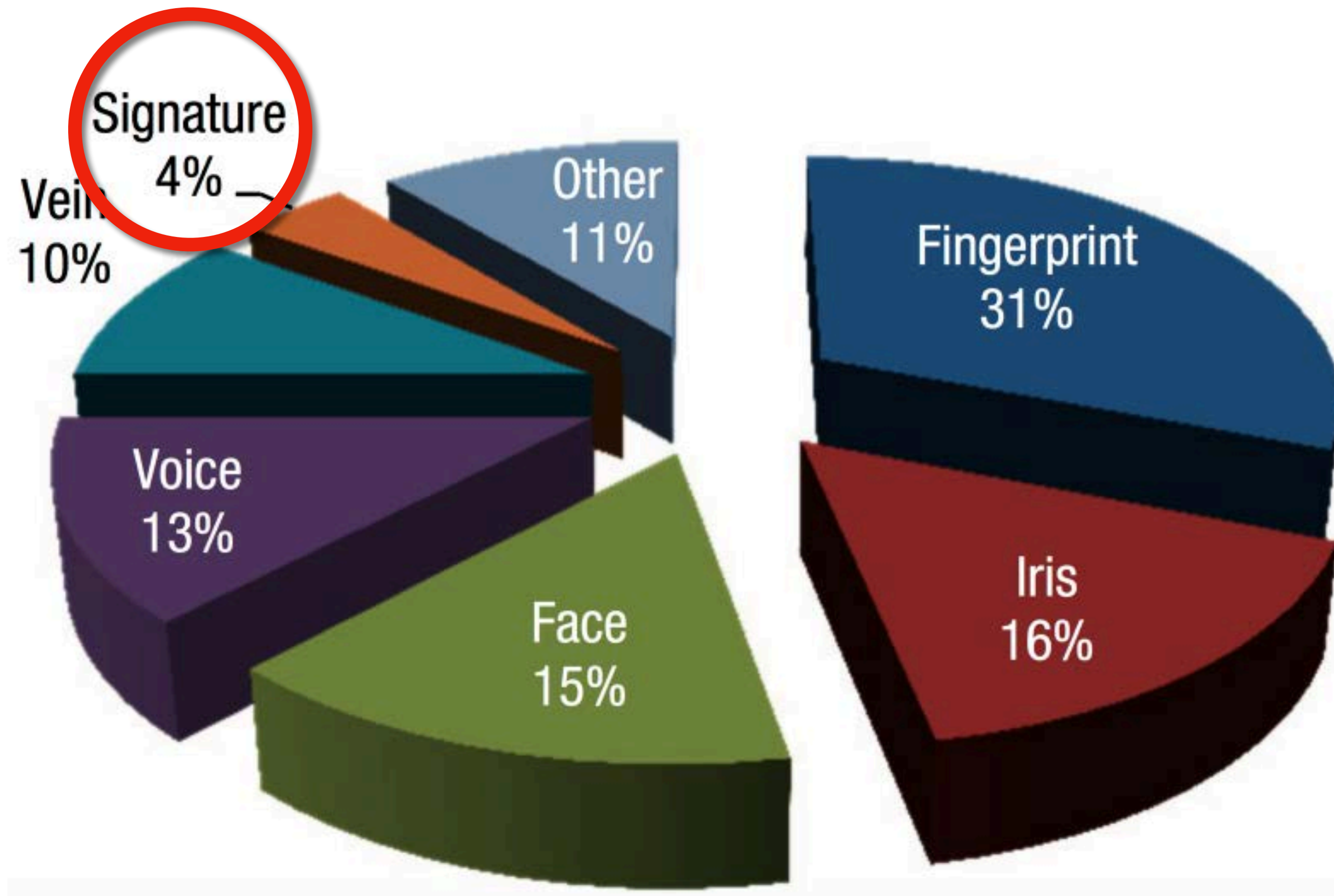
Matrix of thermal sensors



Raw matrix image

Alternative Traits

Market



Source: Mani and Nadeski, *Processing solutions for biometric systems*, Texas Instruments, 2015

Signature Recognition

Behavioral Trait



Signature Recognition

Acquisition

Off-line



On-line



<https://www.youtube.com/watch?v=Y1449t0o7Xw>

Signature Recognition

Off-line Acquisition

Based on visual content only.

General-purpose sensor
(e.g., scanner, camera).

Not necessarily aided by a computer.

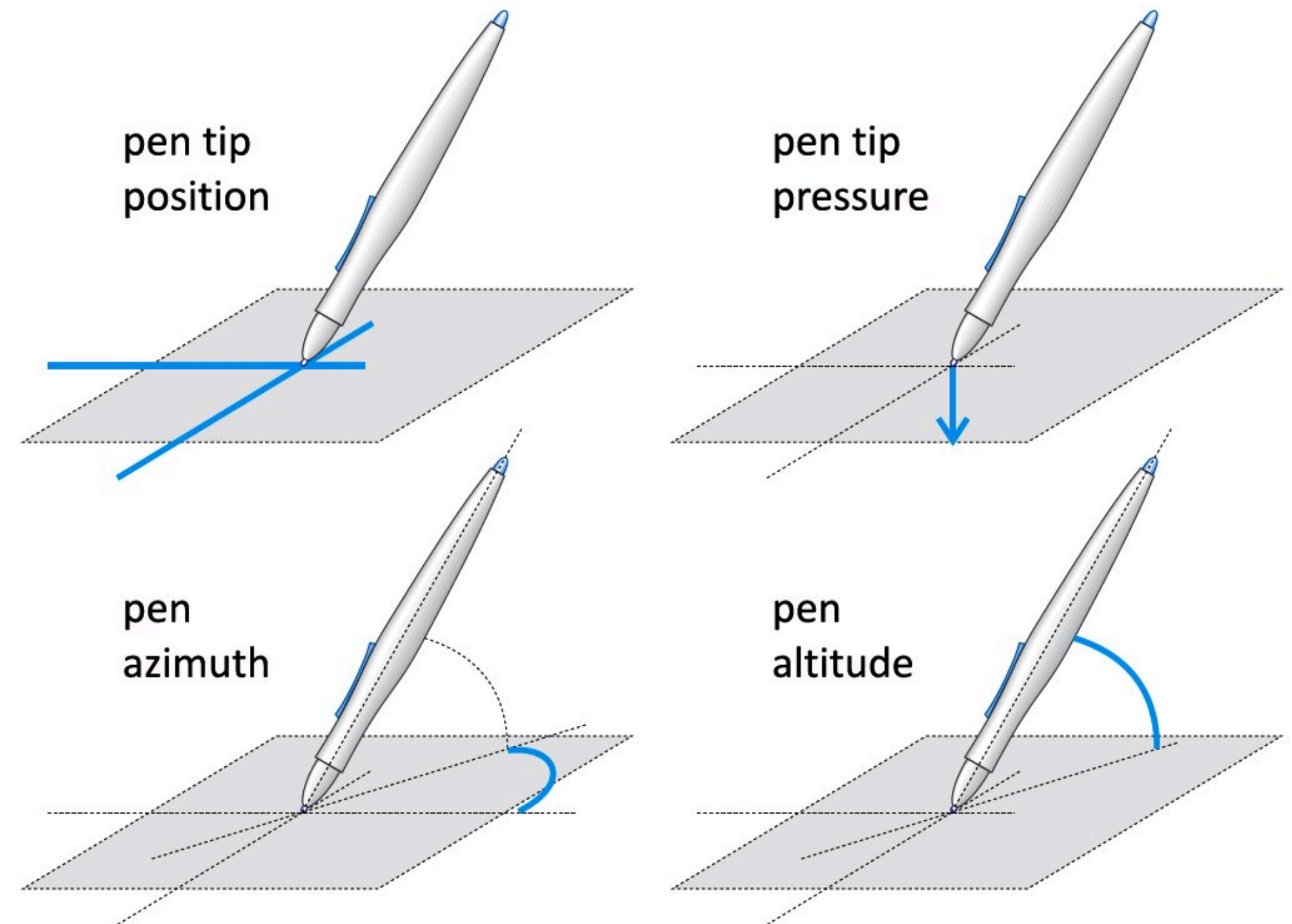


<https://www.youtube.com/watch?v=NPf2otAxB8U>

Signature Recognition

On-line Acquisition

Various components are captured from the signing behavior.



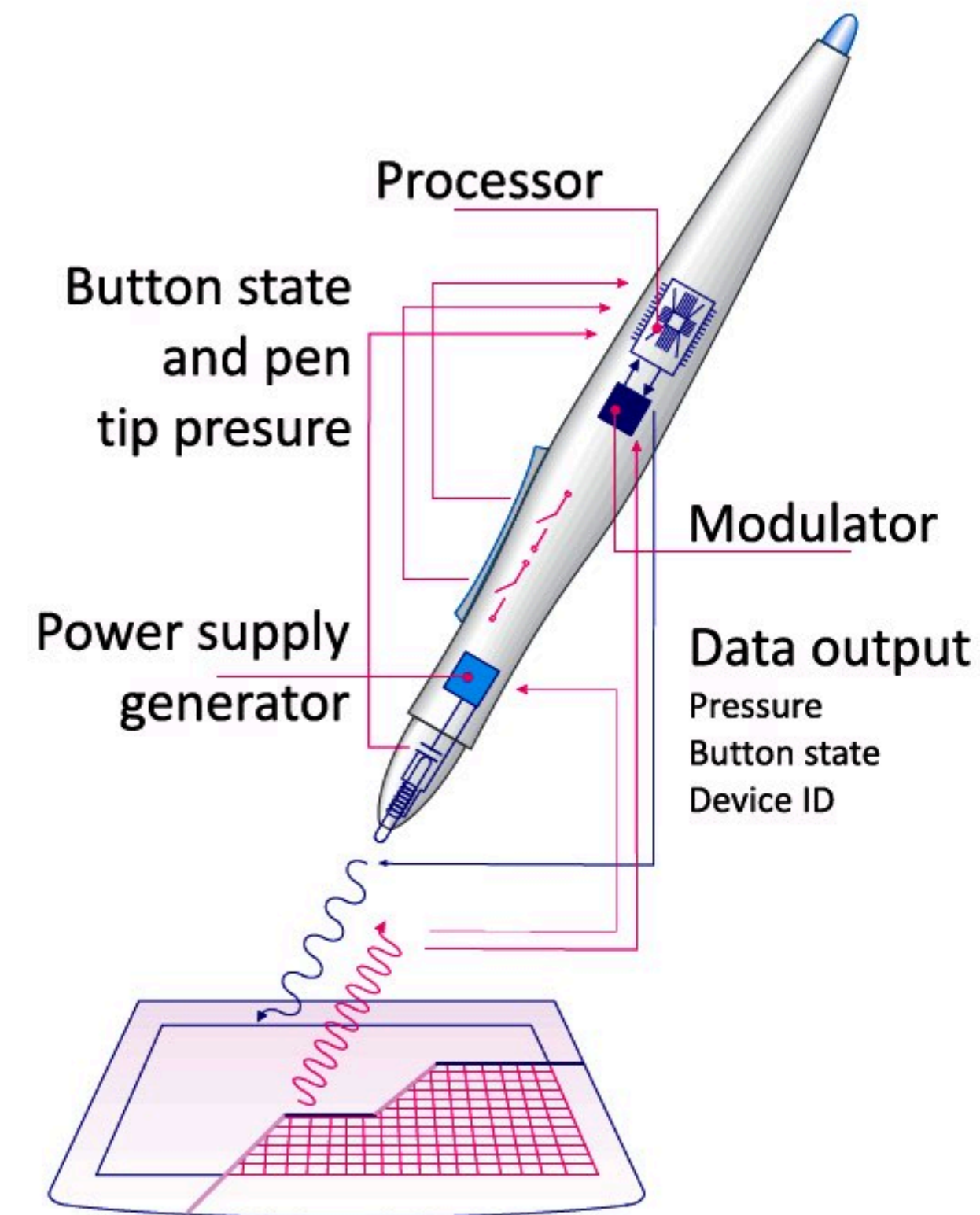
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Signature Recognition

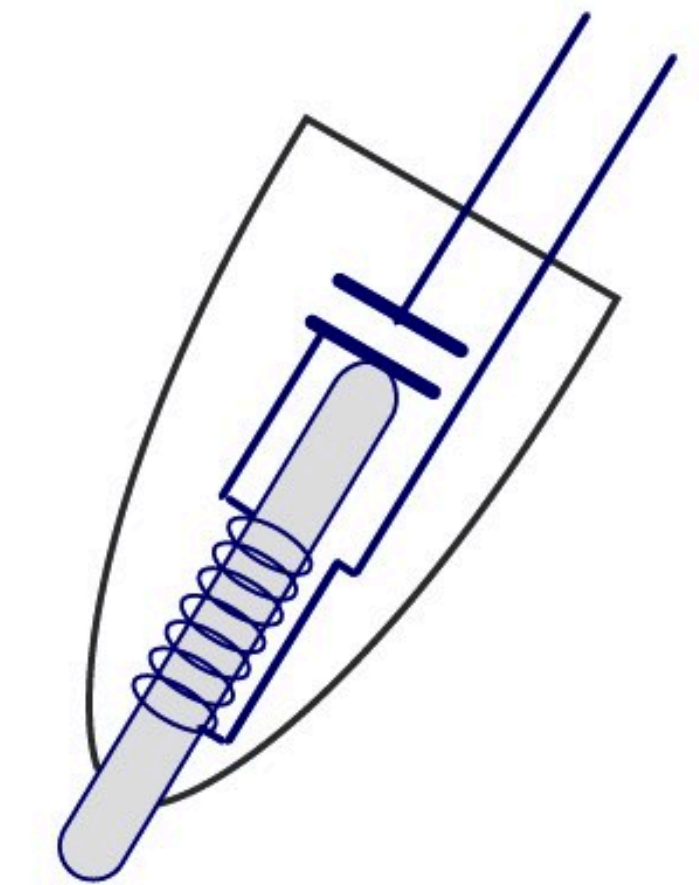
On-line Acquisition

Various components are captured from the signing behavior.

Special sensors (such as digitizing tablets).



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Inductor-capacitor circuit (LC circuit)

Signature Recognition

On-line Acquisition

Various components are captured from the signing behavior.

Special sensors (such as digitizing tablets).

Aided by computer (*acquisition, enhancement, feature extraction, matching, decision*).



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Signature Recognition

On-line Acquisition

Signature Tokens



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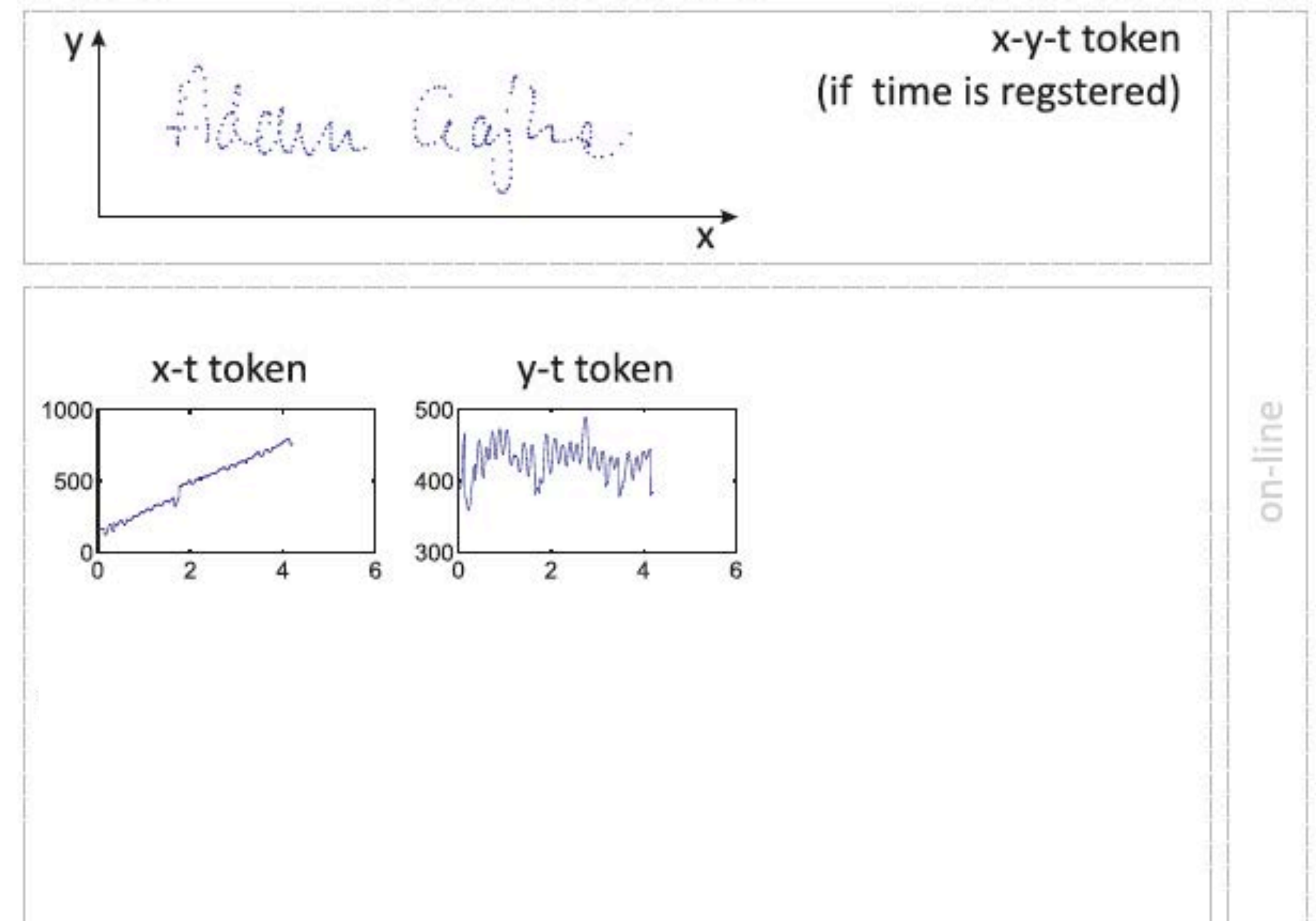
Signature Recognition

On-line Acquisition

Signature Tokens



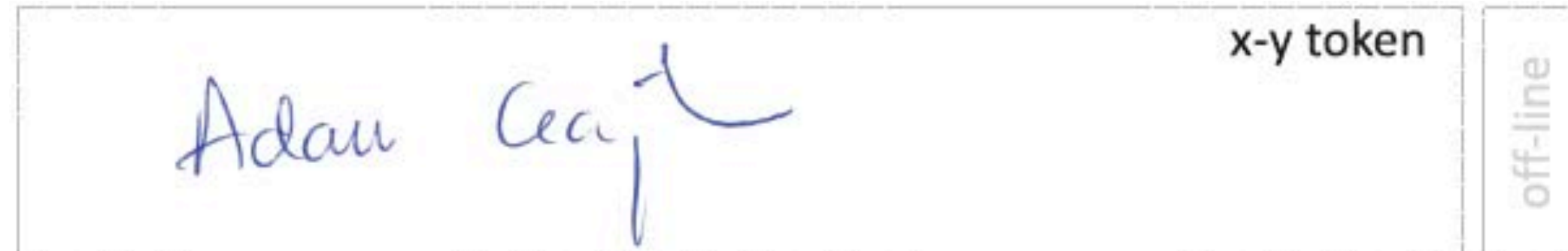
Dr. Adam Czajka



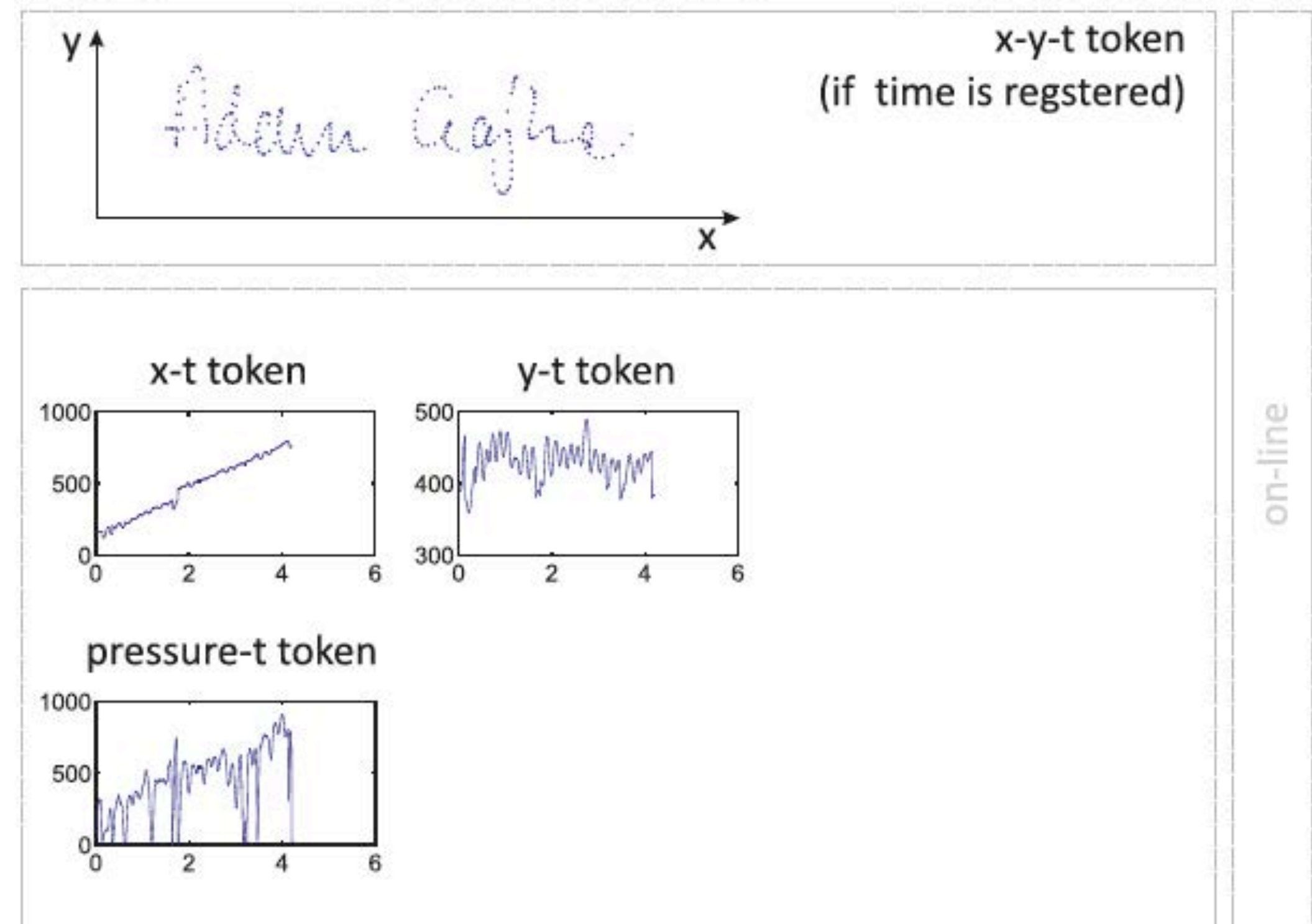
Signature Recognition

On-line Acquisition

Signature Tokens



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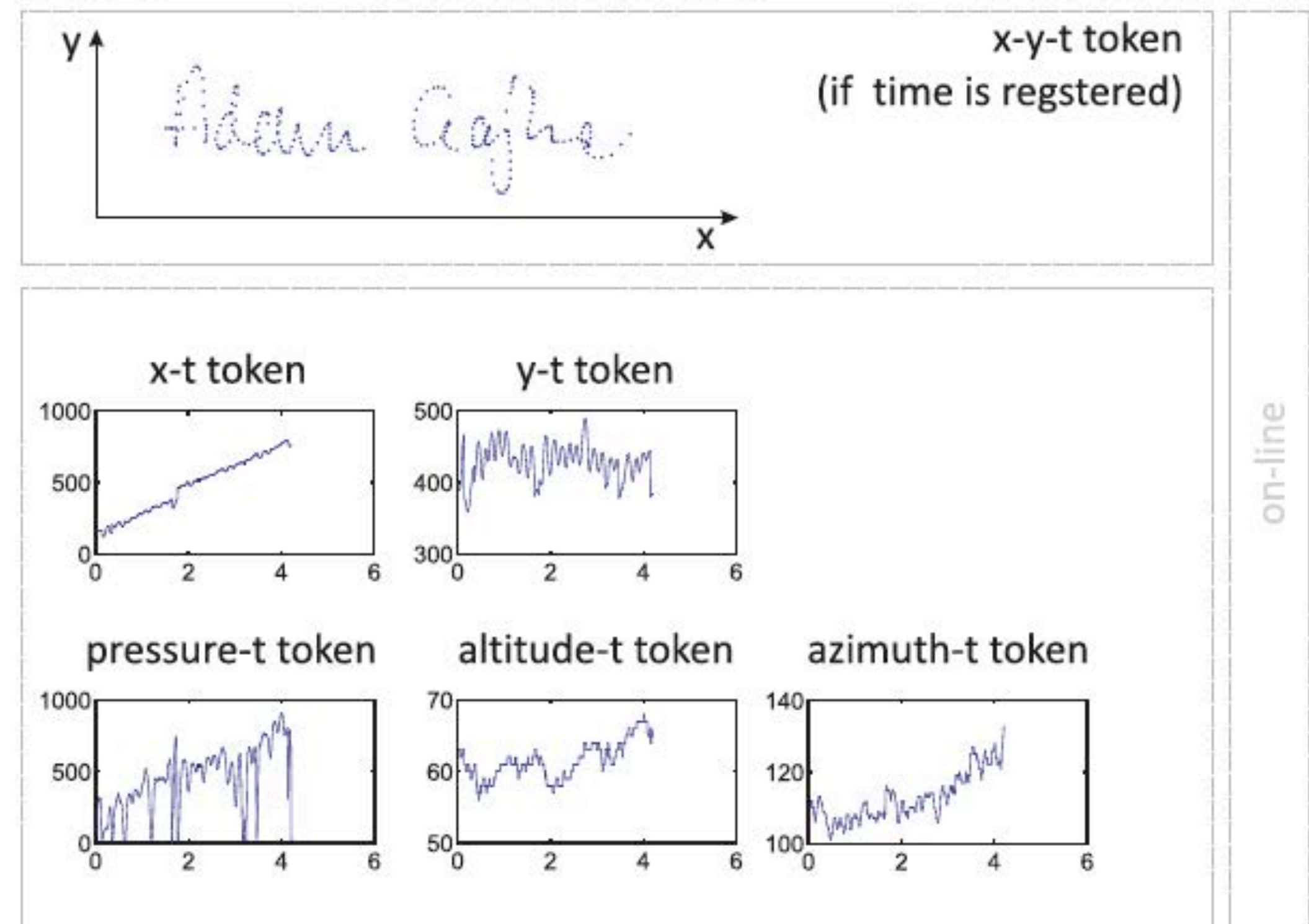
Signature Recognition

On-line Acquisition

Signature Tokens



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Signature Recognition

Presentation Attack

genuine token
Adan Ceajt

Signature Recognition

Presentation Attack

genuine token

Adam Ceajt

random forgery

PS trelyk

Whatever,
dude.

Signature Recognition

Presentation Attack

genuine token

Adam Czapka

simple forgery

Adam Czapka

I know your name.

Whatever, dude.

random forgery

PS trelyk

Signature Recognition

Presentation Attack

Dr. Adam Czajka

genuine token

Adam Czajka

simple forgery

Adam Czajka

I know your name.

Whatever, dude.

random forgery

PS thelyk

skilled forgery

Adam Czajka

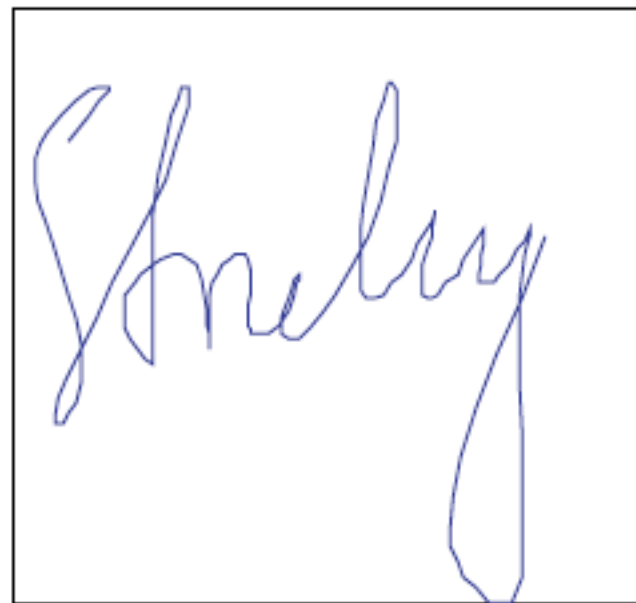
I've seen your signature.



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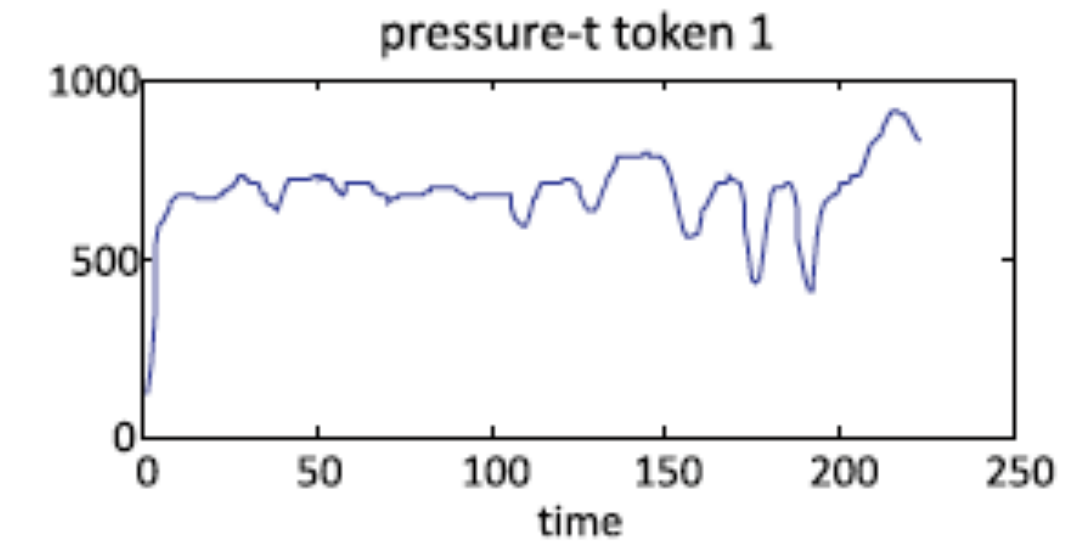
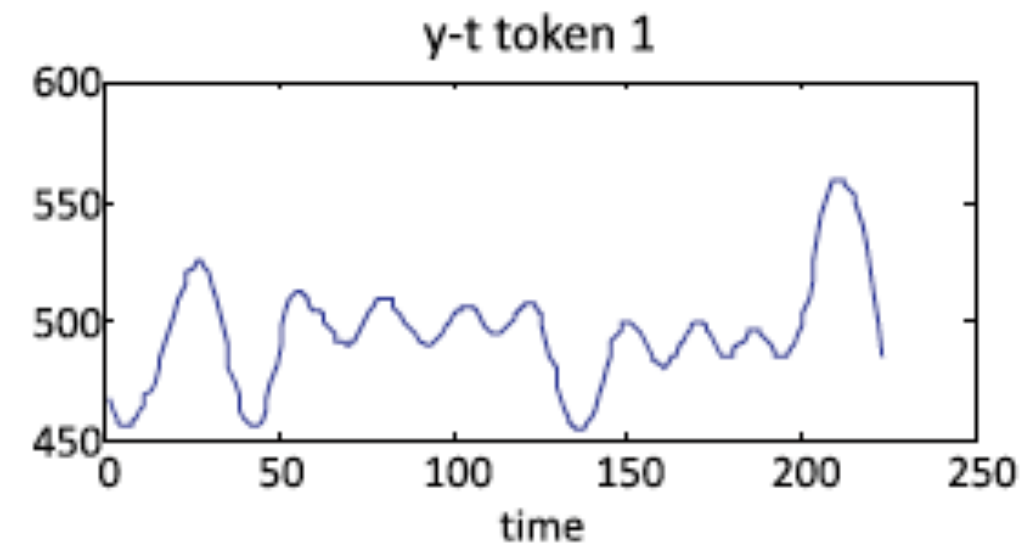
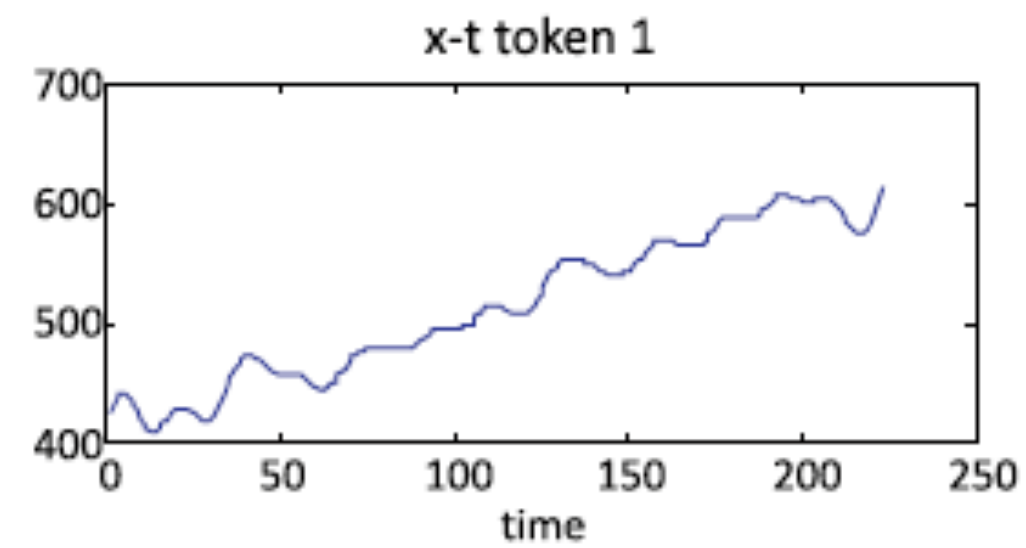
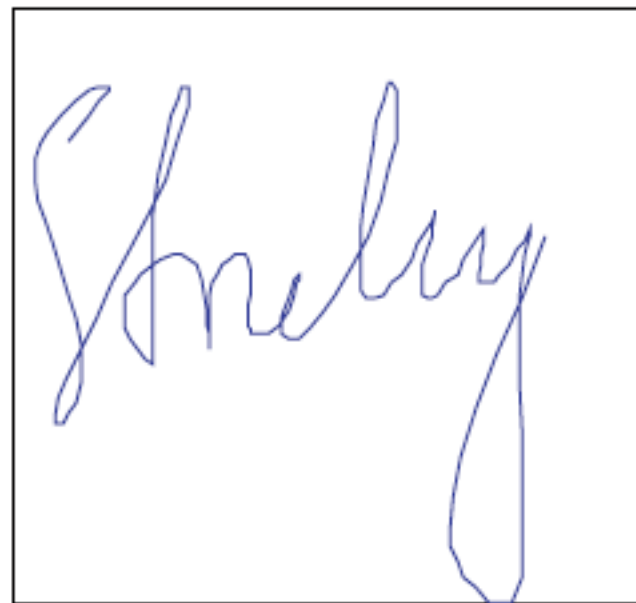
Signature Recognition

Presentation Attack Detection



Signature Recognition

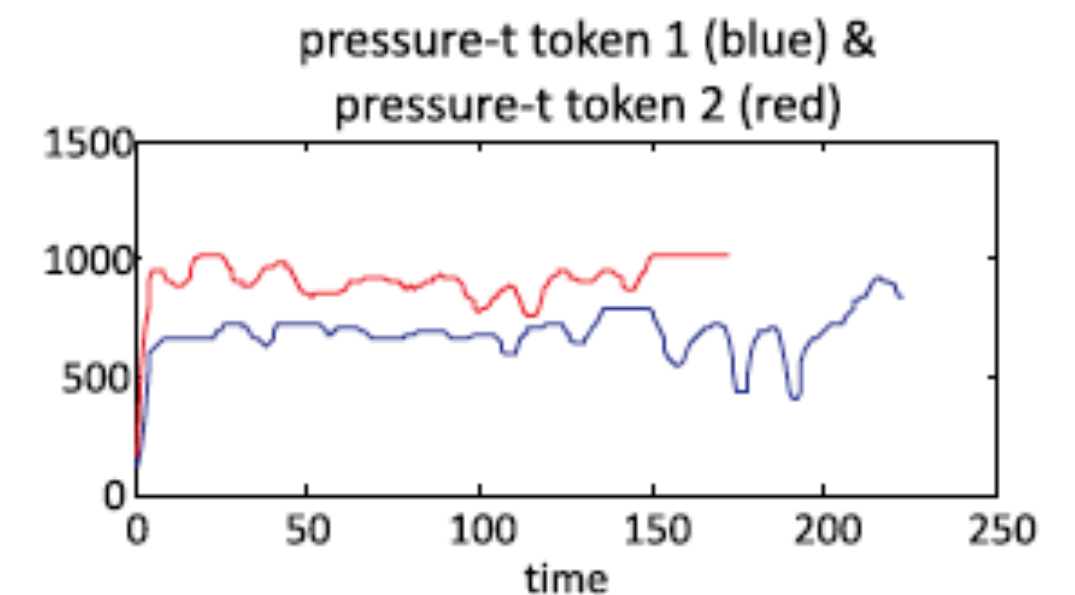
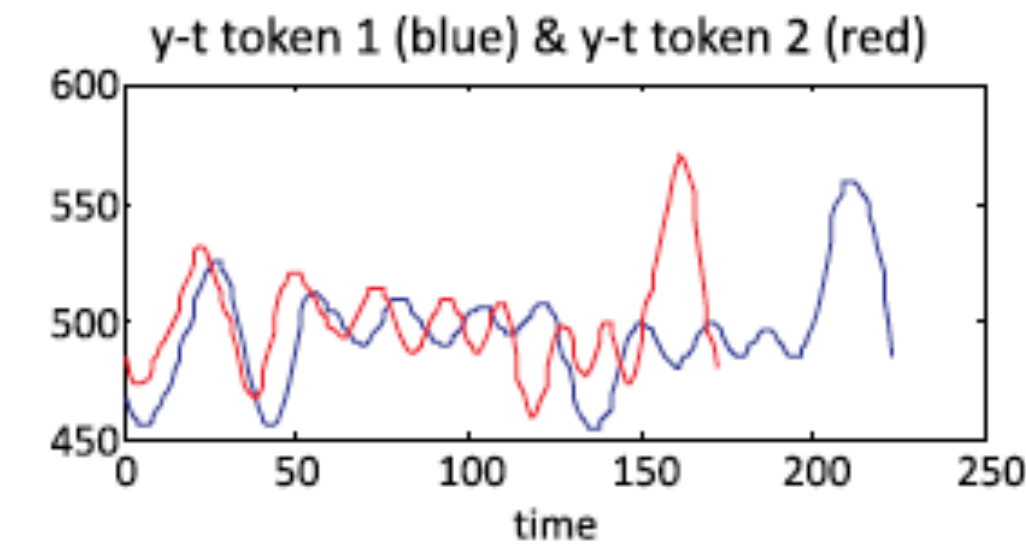
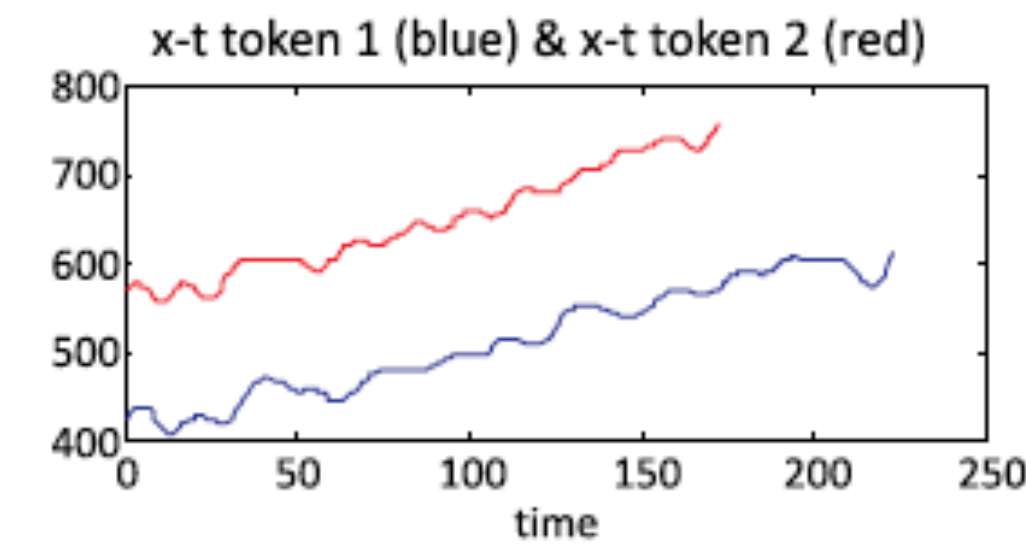
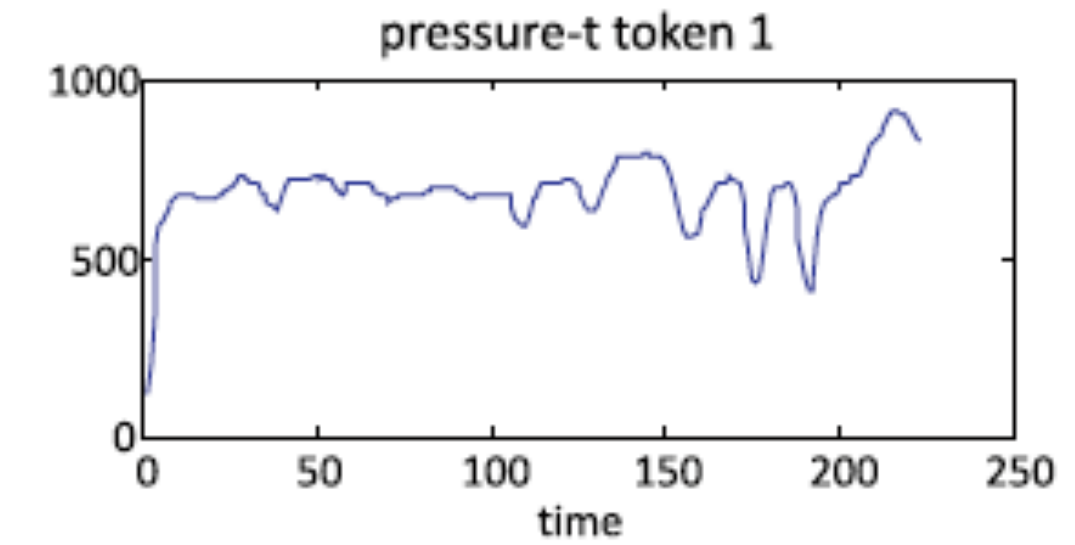
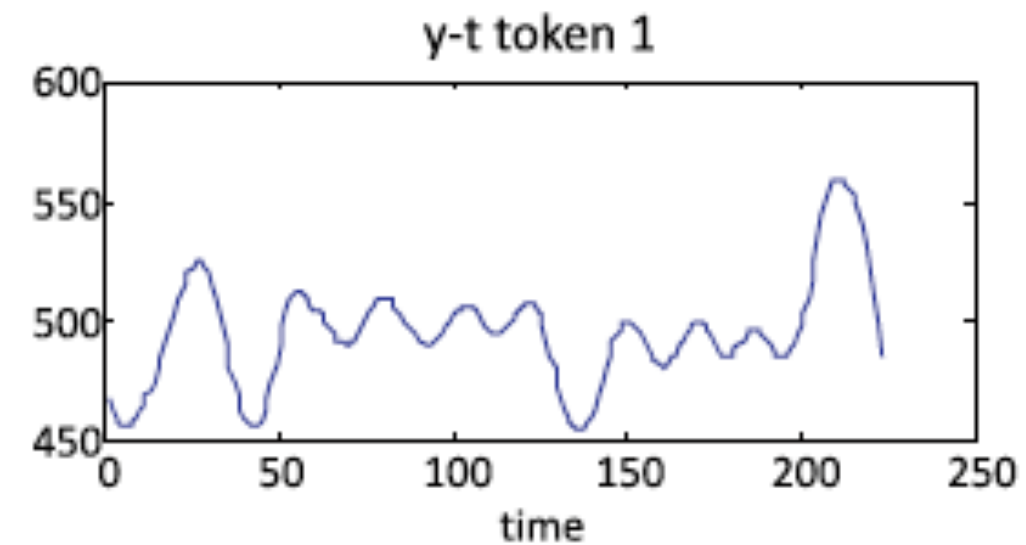
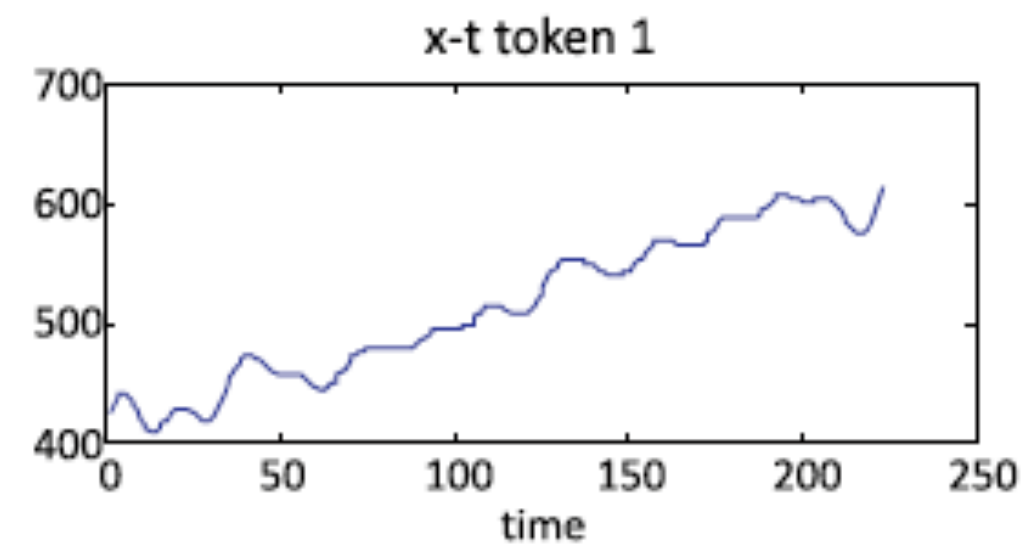
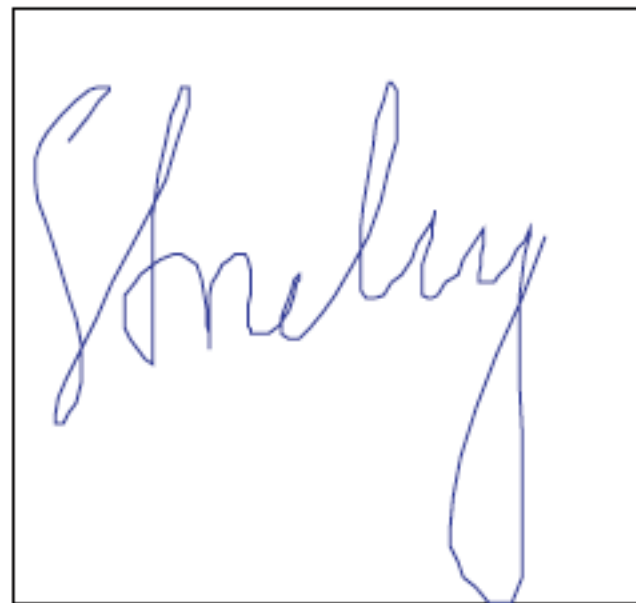
Presentation Attack Detection



Signature Recognition

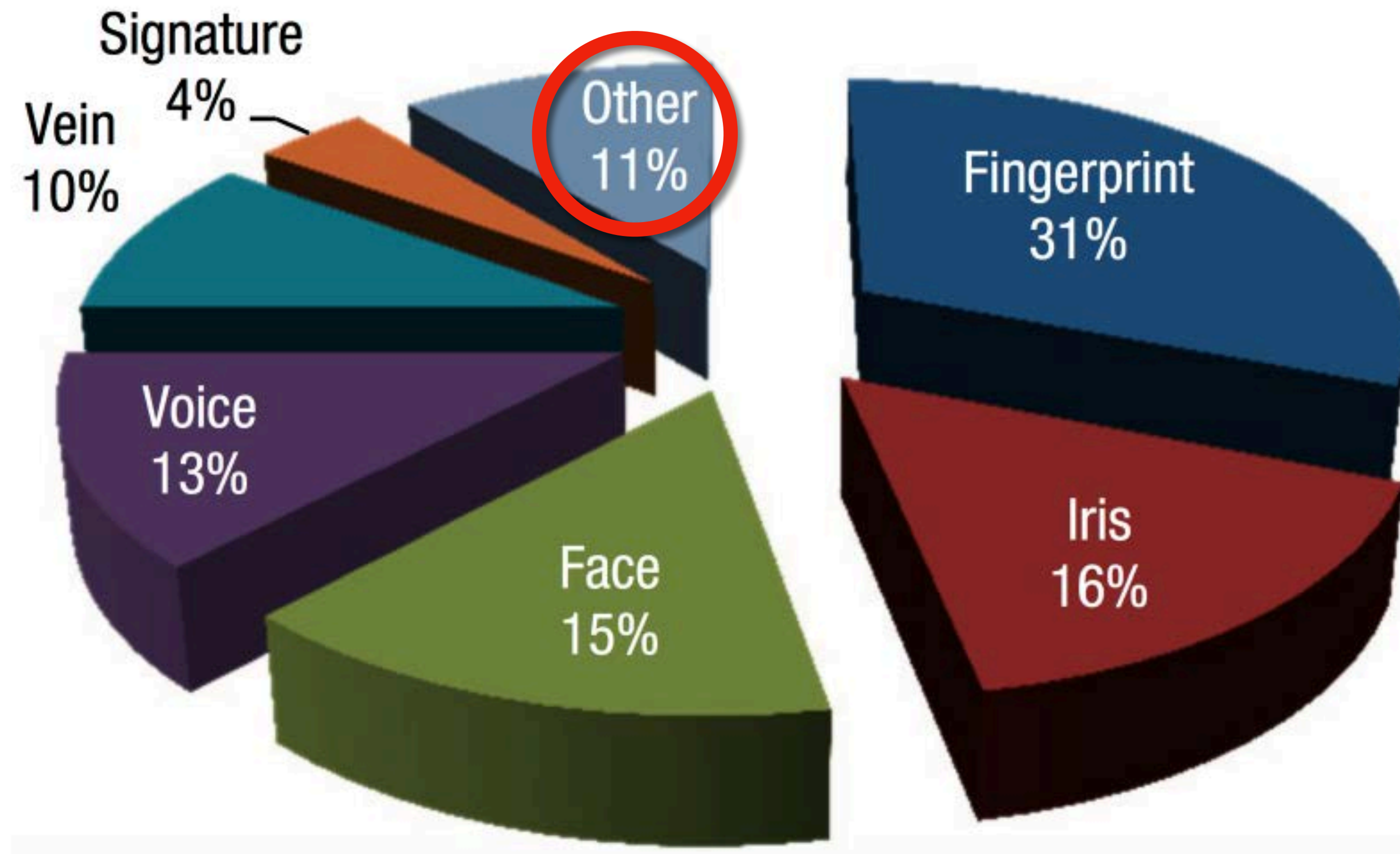
Presentation Attack Detection

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Alternative Traits

Market



Source: Mani and Nadeski, *Processing solutions for biometric systems*, Texas Instruments, 2015

Palmprint Recognition

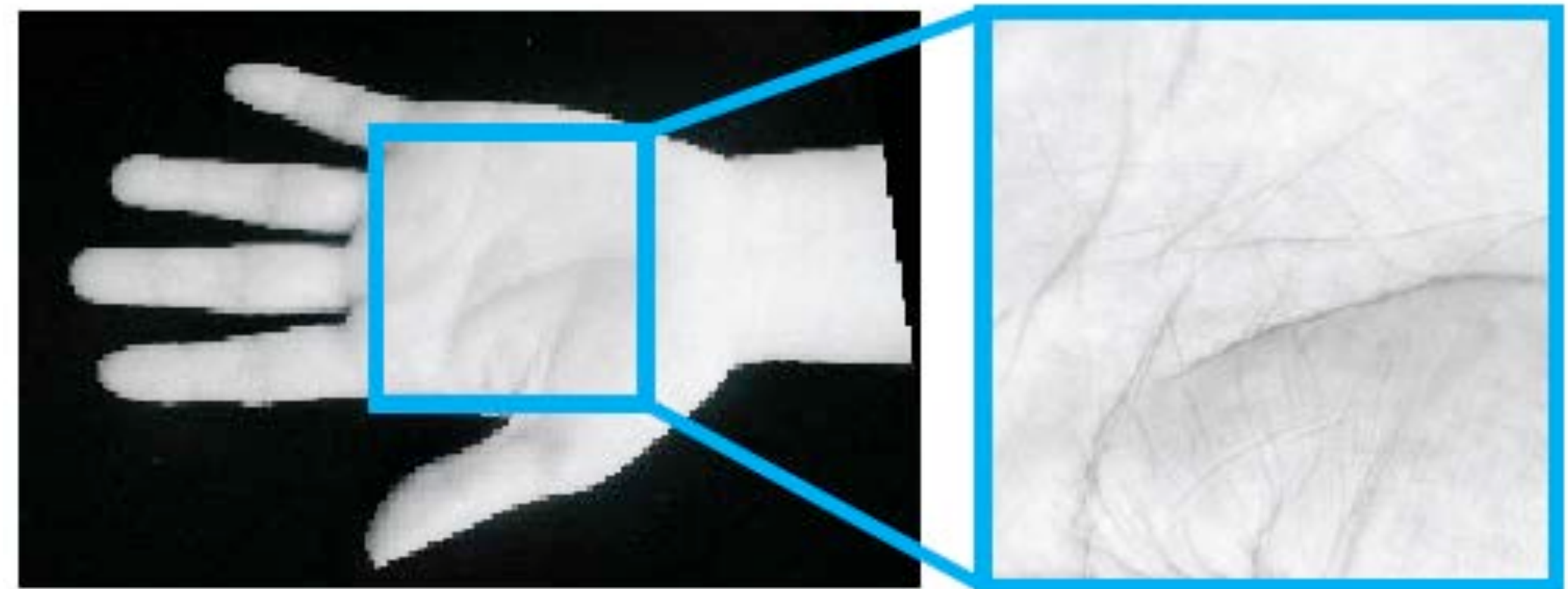
Level-1 Features

Main Lines

Yes: Direction, bifurcations, endings, and crossings.

No: “line of life”, “line of fate”, you name it.

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Palmpoint Recognition

Level-2 Features

Minutiae

Ridge endings and bifurcations
(position and angle).

Focus on the inner and side
portion of the hand.



MITRE
*State of the Art Biometrics
Excellence Roadmap*
Tech. Report, 2008

Palmpoint Recognition

On-line Acquisition



CrossMatch ID 2500
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Other Traits



DNA



Gate



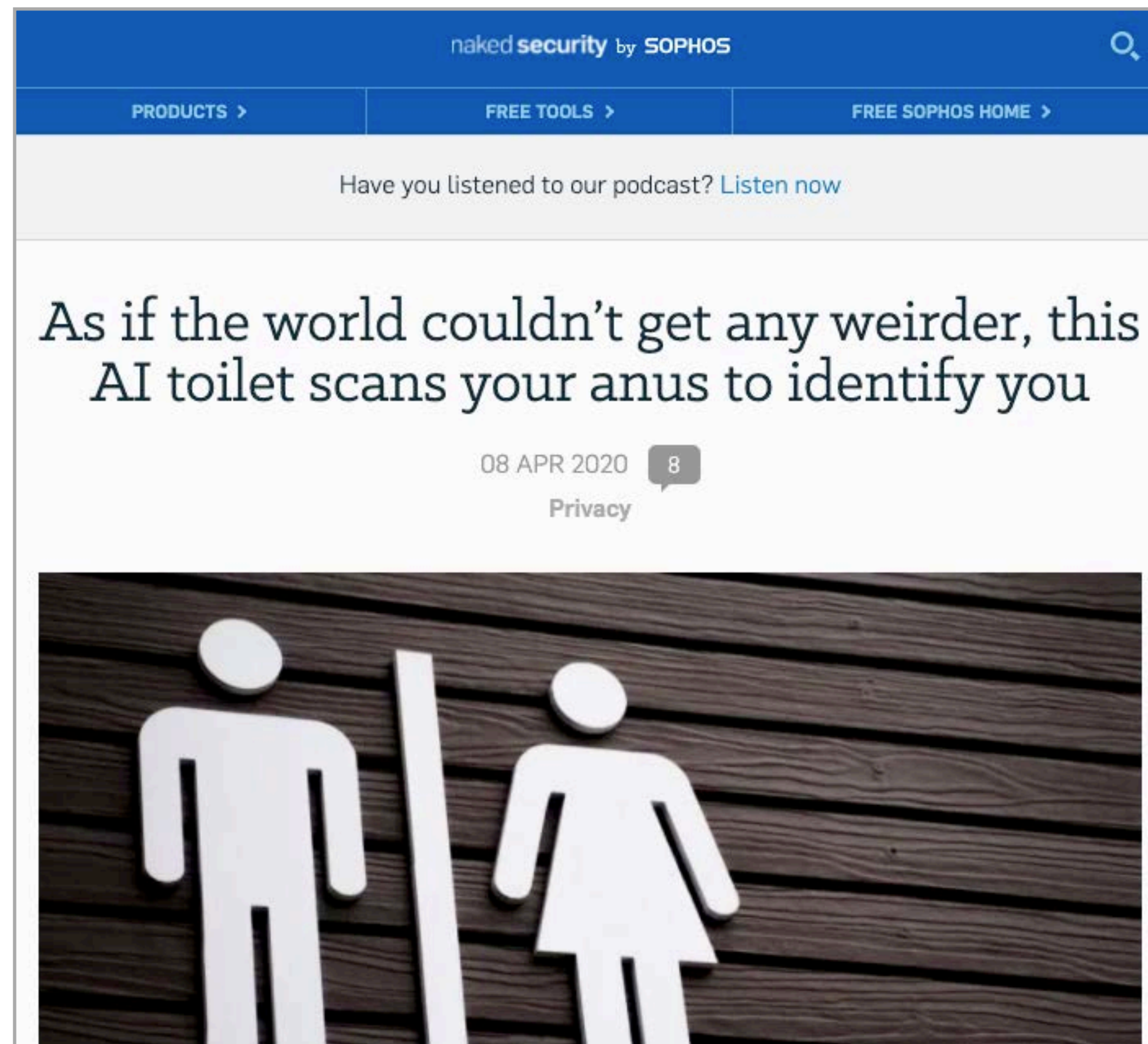
Ears



Tongue Print

Other Traits

Ahem...



<https://nakedsecurity.sophos.com/2020/04/08/as-if-the-world-couldnt-get-any-weirder-this-ai-toilet-scans-your-anus-to-identify-you/>



Soft Biometrics

What it it?

Usage of ancillary information to aid recognition.

Soft Biometrics

What it it?

Usage of ancillary information to aid recognition.

Benefits

Recognition accuracy improvement

Recognition runtime reduction

Soft Biometrics

What it it?

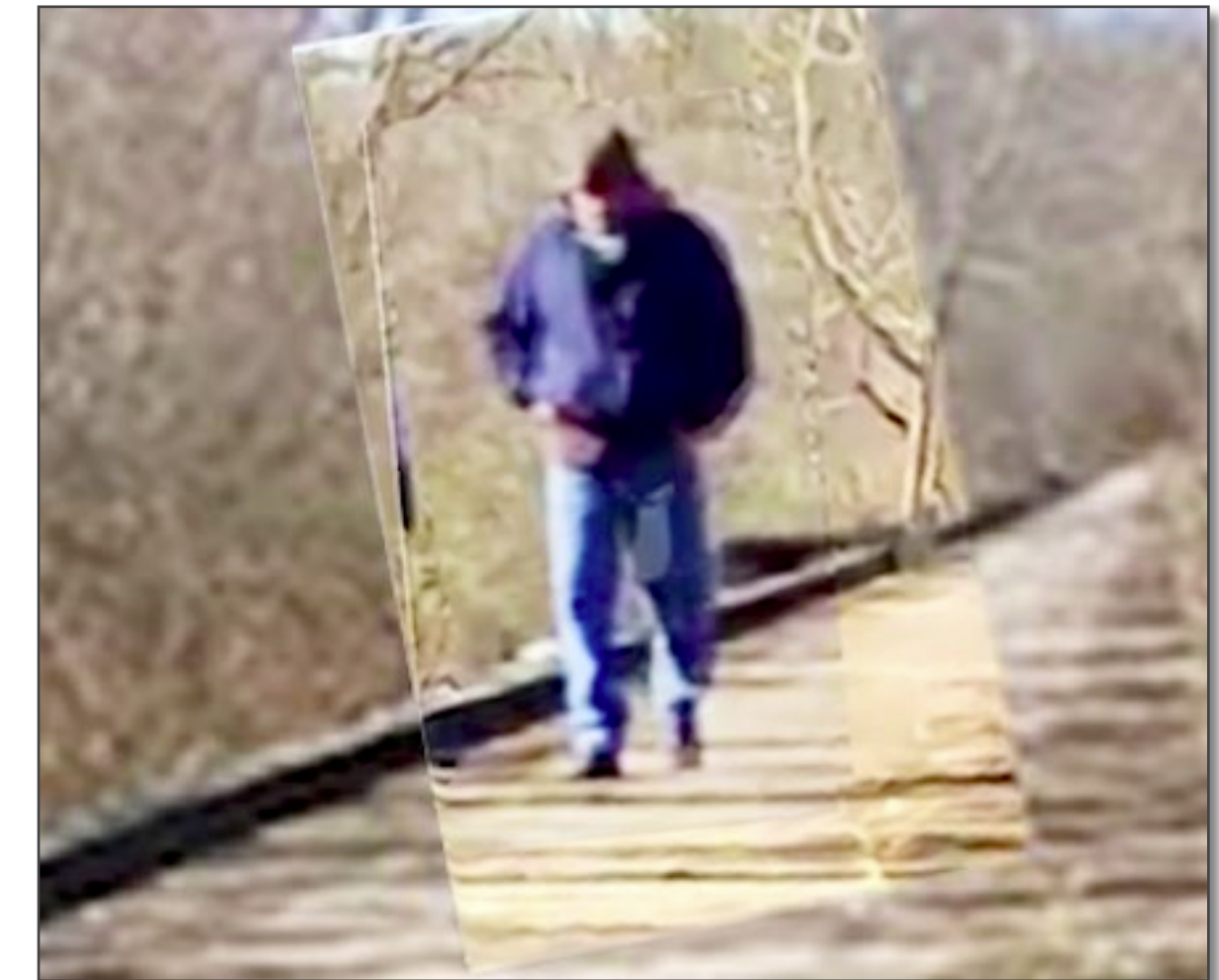
Usage of ancillary information to aid recognition.

Benefits

Recognition accuracy improvement
Recognition runtime reduction

Limitation

Lack of uniqueness and permanence
Lack of universality



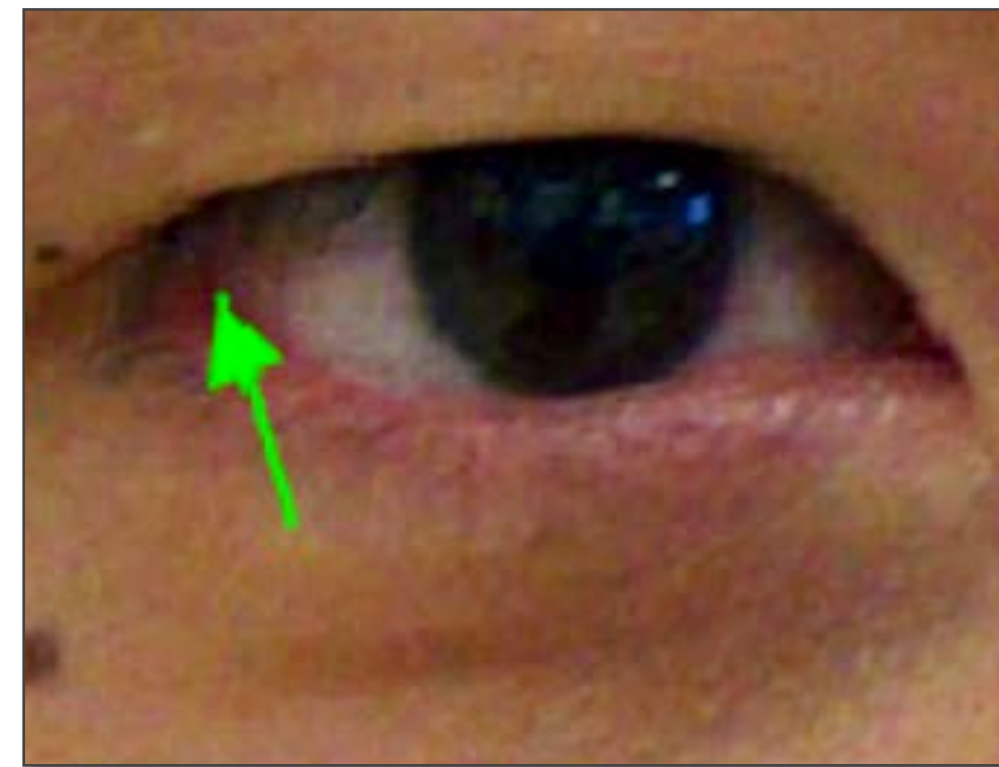
<https://bit.ly/3u81gXd>

Soft Biometrics

What can you guess?

Periocular region and eye color

Jain, Ross, and Nadakumar
Introduction to Biometrics
Springer Books, 2011



Gender?
Ethnicity?
Age?

Soft Biometrics

Other traits

Jain, Ross, and Nadakumar
Introduction to Biometrics
Springer Books, 2011



moles, scars,
marks



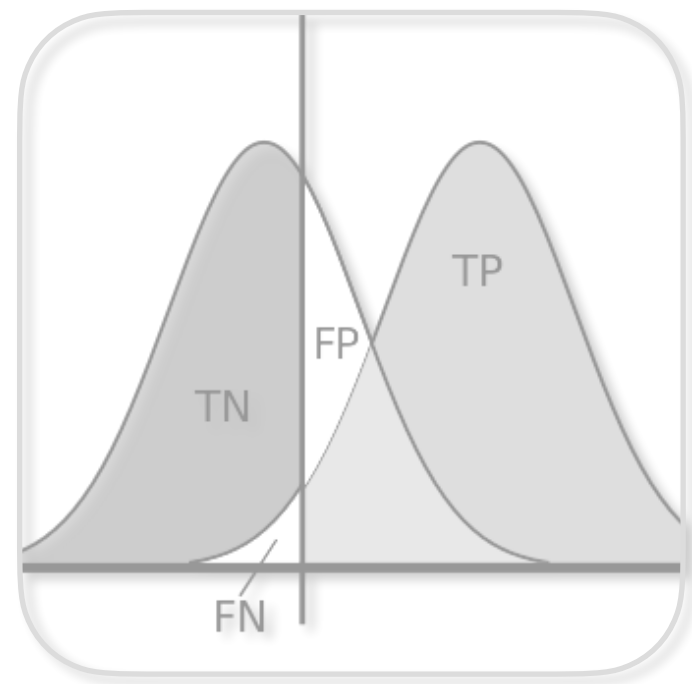
birthmarks



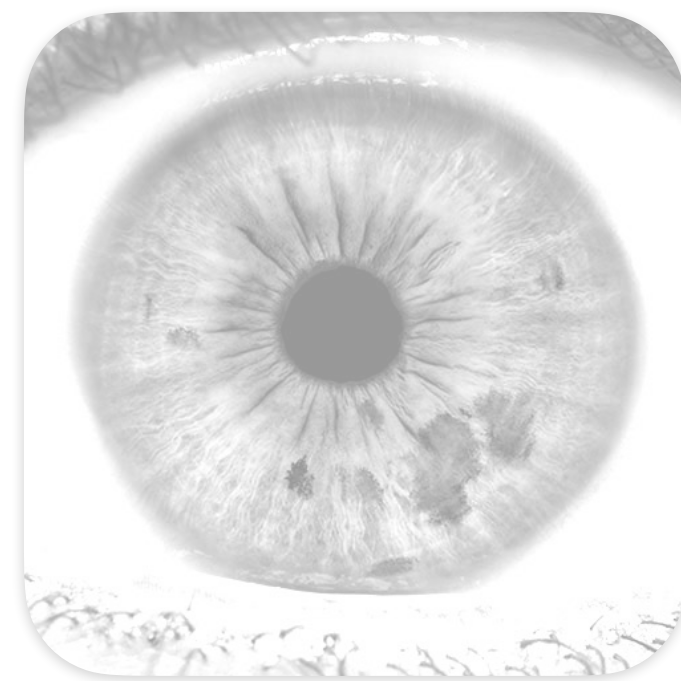
tattoos

What's Next?

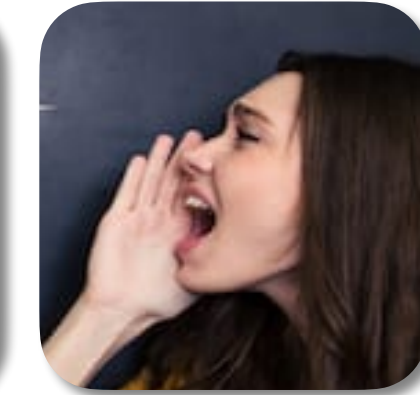
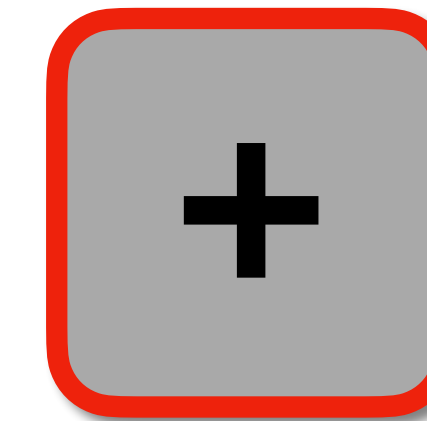
Fusion (a.k.a. Multibiometrics)



Basics
Concepts
Metrics
Metric
implementation



Core Traits (3)
Concepts
Baseline implementation
Data collection
Evaluation
Attacks
Assignments



**Alternative Traits and
Fusion
Concepts**



Invited Talks (2)
State of the art
Future work