Federal Office
for Information Security

Steps & Stones with Presentation Attack Detection - PAD projects @ BSI

NIST - IBPC

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German Federal Office for Information Security (BSI)

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1. PAD @ BSI (overview)
2. Project „OCT-II“
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1. PAD strategy & BSI

A. Threat Assessment

continuously collect & develop attack methods, „State of the Art“ -Tests

presentation-attacks

B. Countermeasures

development of fake detection technologies, close contact to manufacturers

C. Tests & Certification

development of test & certification methodologies, international standardization

2. Project “OCT-II”: Motivation

BSI is looking for alternative fp-technologies to improve:

- **Security:**
  Fingerprint devices with “state of the art” PAD provide a considerable protection against known presentation attacks, but they still can be fooled by cheap & easy obtainable new materials

- **Quality/Applicability:**
  - worn out fingerprints are a huge problem for most devices
  - using fingerprints of children (esp. babies) would be helpful in fighting child trafficking, bit they are very difficult to capture in sufficient quality (see JRC-presentation)

2. Project “OCT-II”: Wish list

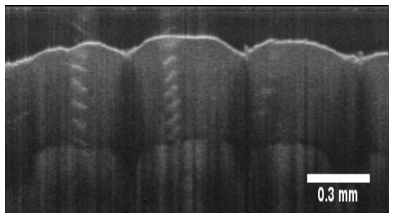
- one sensor-technology, that captures specific robust & universal human features that are very hard/impossible to copy
- simple fusion: every feature must exist
- very high resolution
- touchless (avoiding local distortions)

additional practical constraints (border control scenario):

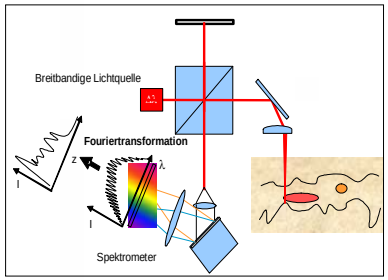
- max scanning time: 3 s
- max processing time: 6 s
- very low influence on FRR

2. Project “OCT-II”: proof of concept

Project “OCT-Finger“ (2012)

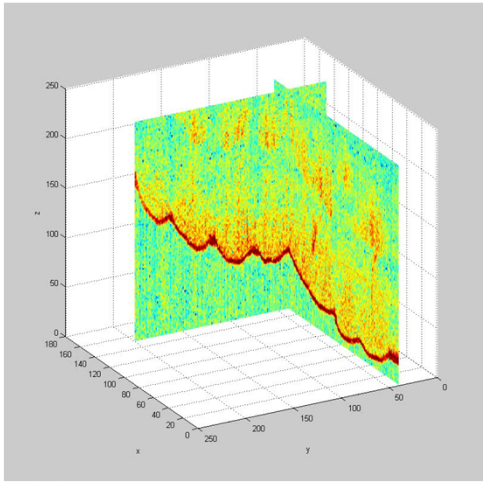


- “Optical Coherence Tomography“ (OCT) for detailed 3D-measurement of the finger up to a depth of 2mm with a resolution of up to 12µm in all 3 dimensions



- Features:
  - **outer & inner fingerprint layers** (inner: epidermis-dermis barrier).
  - **sweat glands** (spiral shape, direction, localization)
  - **NIR analysis, layer thickness & structure, pulse(OCT-doppler), location of pores, etc…**

2. Projekt „OCT-II“: proof of concept



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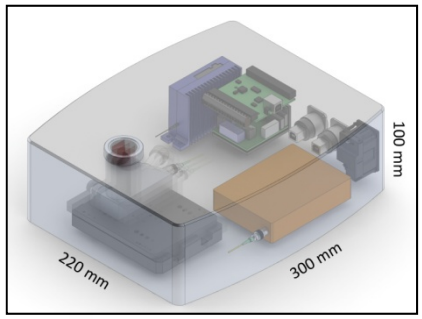
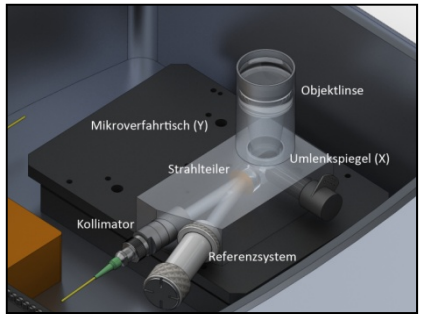
- Features:
  - **outer & inner fingerprint layers** (inner: epidermis-dermis barrier).
  - **sweat glands** (spiral shape, direction, localization)
  - **NIR analysis, layer thickness & structure, pulse(OCT-doppler), location of pores,** *and many more***…**
- first results promising, but not sufficient →new HW

2. Project „OCT-II“: goals





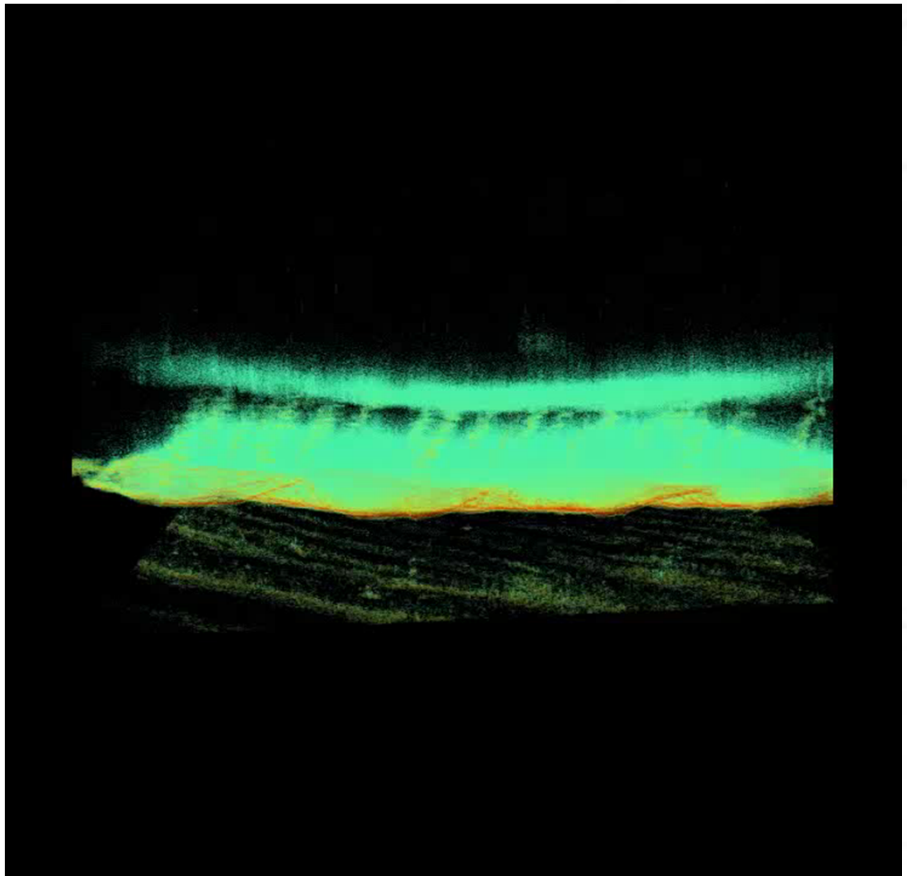
- Start: Jan 2014 (Meissner Engineering, FhG IZFP)
- development of 2 prototypes:
  - 1x „high end“, very high speed & resolution
  - 1x „low end“, optimized for lowest cost
- both devices are mobile w. separate measurement heads
- Area of measurement: 19x19x6mm with up to 7µm

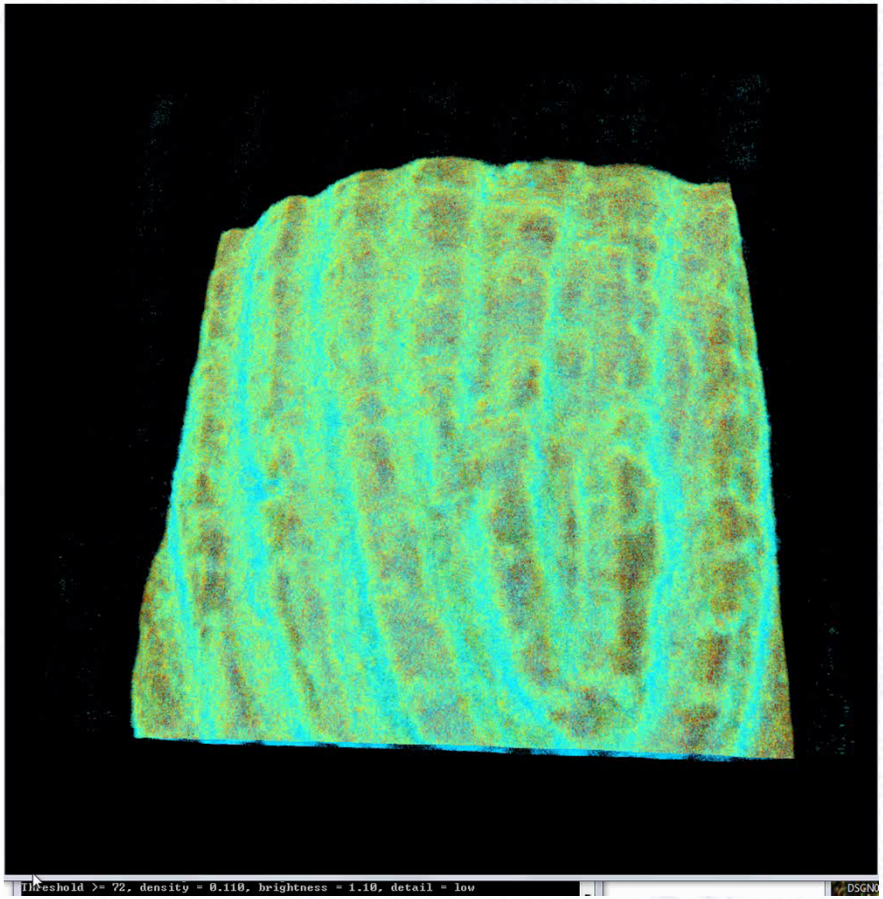
Fields of applications:

- Use Case: 2nd line for automated border control
- extreme applications like children
- basis for further F&E,
- reference for achievable level of security

2. Projekt „OCT-II“: first results

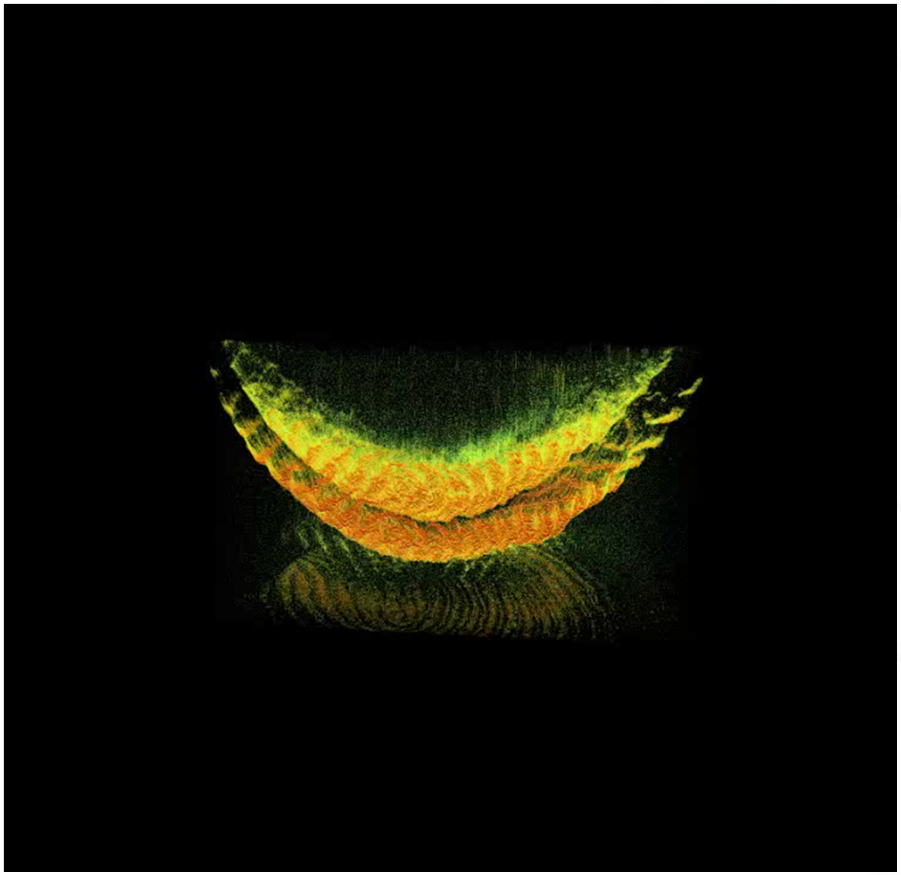
real fingers:

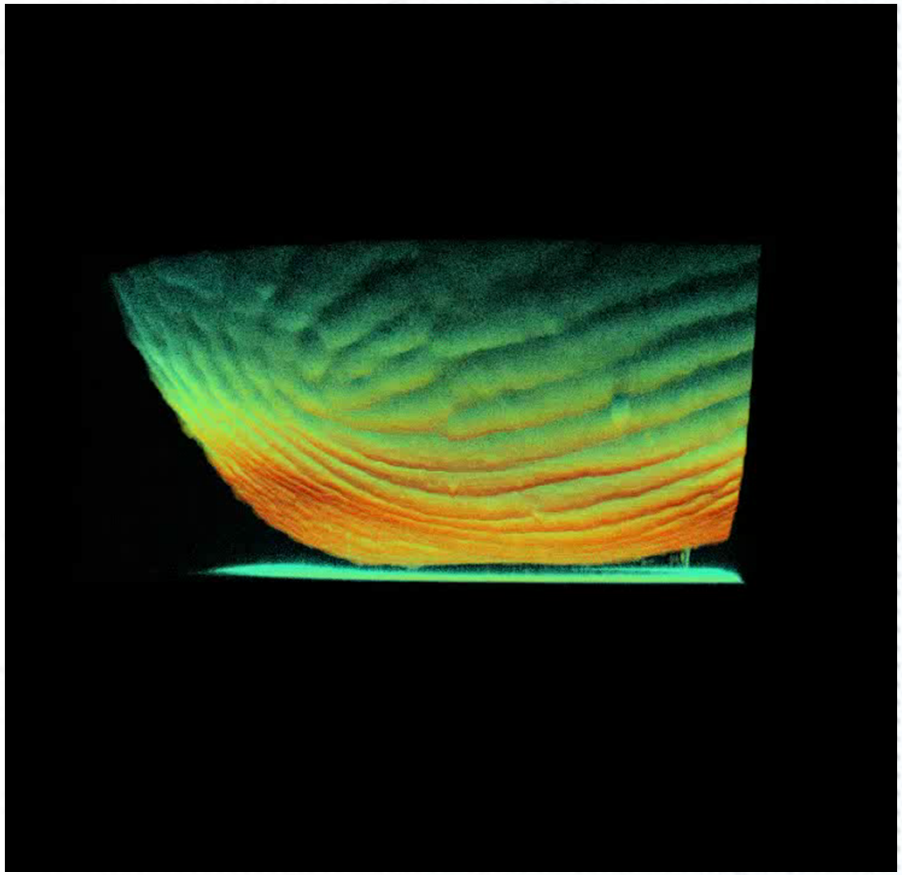




2. Projekt „OCT-II“: first results

artefacts:

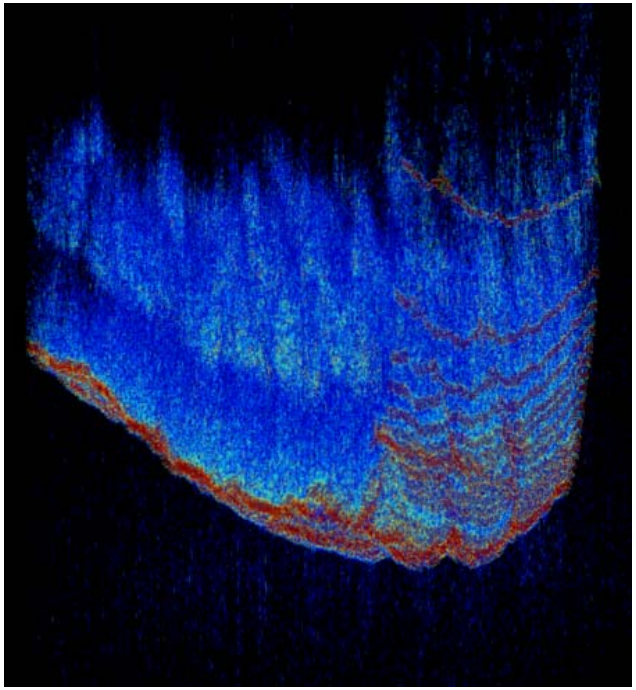




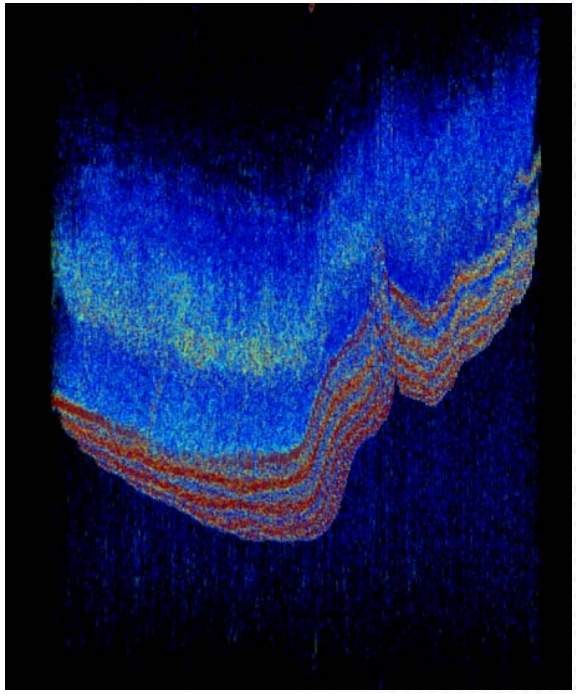
2. Projekt „OCT-II“: first results

things that can go wrong:

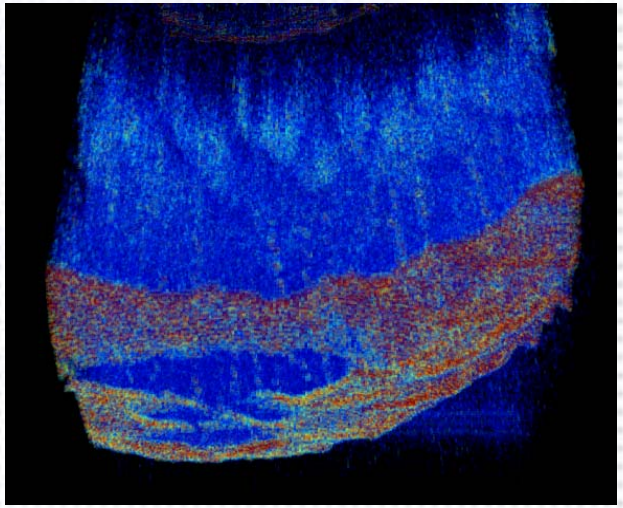
early lift off:



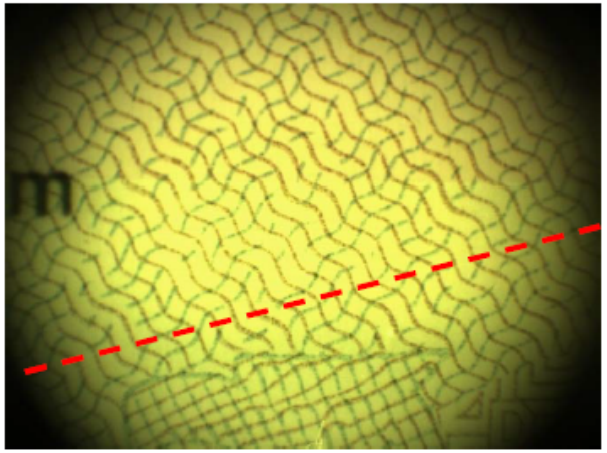
strong shaking:



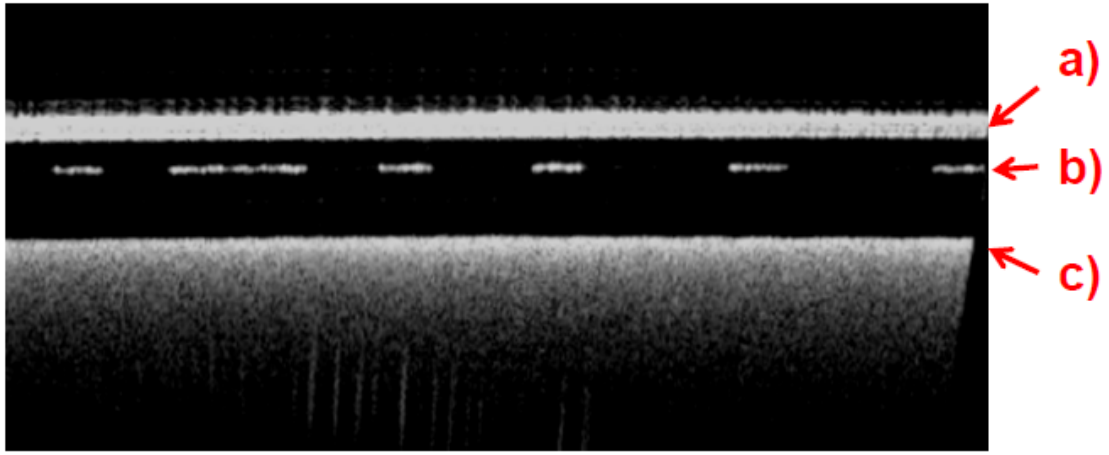
outside sensor area:



2. Projekt „OCT-II“: additional application eID



Kamerabild, Draufsicht
+ Lage des Schnittbildes



Querschnittsbild, OCT-B-Bild

2. Projekt „OCT-II“: Challenges

- data management (up to 8GB of raw data)
- scanning time (highest res only partially)
- design of the measurement head (finger handling)
- development of highly efficient algorithms for biometric and PAD-feature extraction and classification:

  cooperation with Gjøvik University College, Norway (Christoph Busch)

  ➔ new, very promising approaches, developed by PHD student Ctirad Sousedik make our goals achievable!

3. Concept for a rapid test for vulnerability analysis in face recognition

In a cooperation between BSI and BVA (Federal Office for Administration) Manuel Koll wrote the bachelor thesis:

"*Development of a rapid test for evaluating the vulnerabilities of face recognition systems against fake attacks*"

with the aim to:

- develop a concept for a rapid vulnerability test (1 day), optimized for :
  - testing "on site" of normal operation
  - low resources, regarding the number of testers, artifact variants, attack repetitions
- define a set of currently known presentation attacks for face biometry
- interview international experts on vulnerability testing in biometrics
- use existing concepts of Common Criteria (wherever possible)
- be a first step towards a certification methodology

3. rapid test in face biometry: set of PAs

- **2D-photos**
  - on paper (various sorts & sizes)
  - on clothes (T-shirt attack)
  - on Displays (smartphones & tablets)
- **Videos** (smartphones & tablets)
- **3D-Models** (augmented reality Apps on smartphones/tablets)
- **3D-Masks,** made of:
  - paper
  - silicone & other soft materials (3D-printed casting molds, bought)
  - plastic (3D-printer)
  - polymer plaster (colored 3D-print, various sizes)

3. rapid test in face biometry: set of PAs

- **2D-Photos:**
  - **on paper (size: 10x15cm – DIN A3, materials:normal, glossy & matte)**

F1a-c: Foto 1_MH	F2a-c: Foto1_OH	F3a-b: Foto2_OH	F4a-b: Foto2_ZOH
			

  - **on clothes:**
  - **alterations:**
    - **cut out the eyes**
    - **cut out the face (better background)**
    - **bend around head**

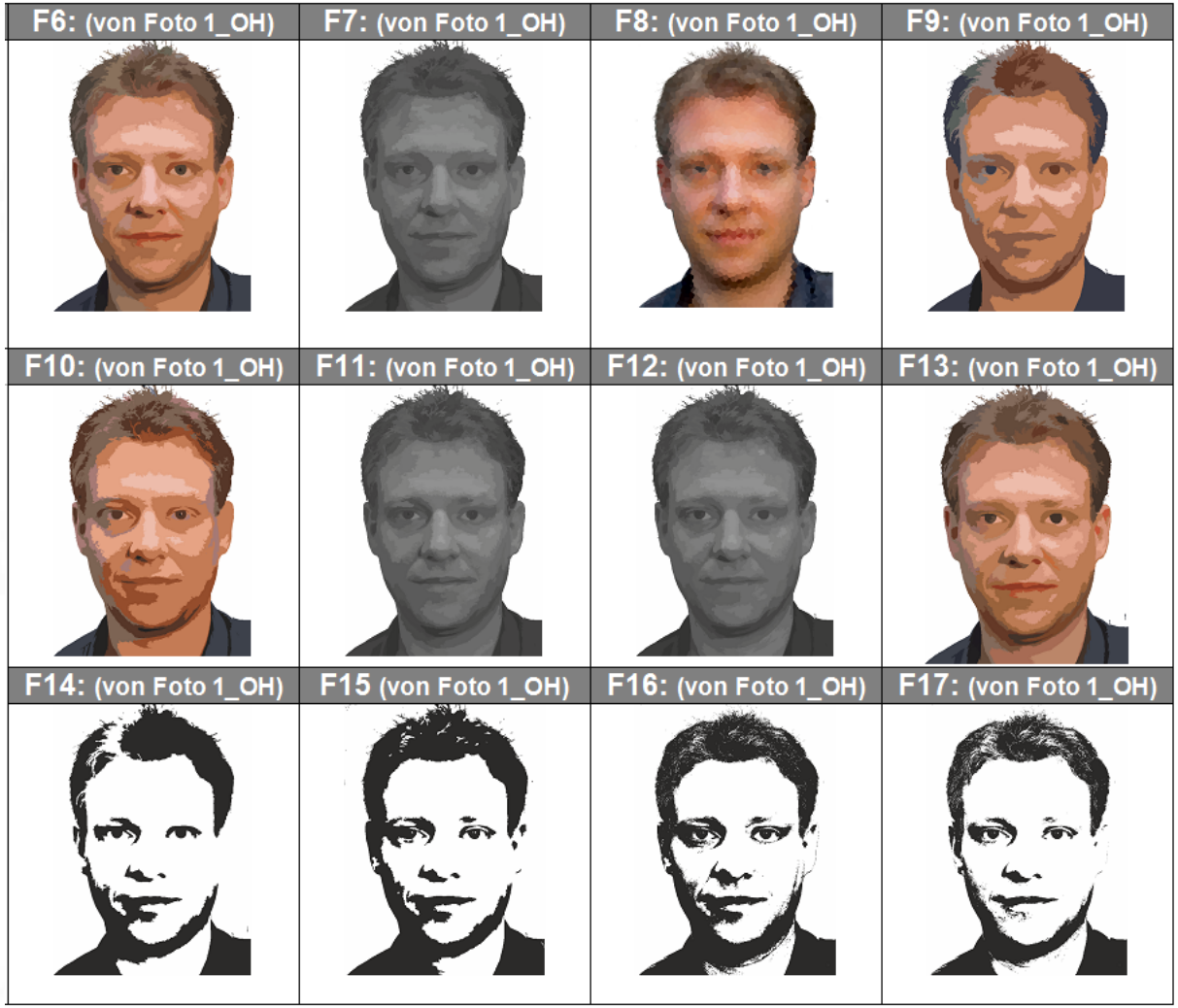
F20: T-Shirt_#1

3. rapid test in face biometry: set of PAs

- **2D-Photos:**
  - **color alterations**

(conceiling the attack against a supervisor,

test of the biometric component,)



3. rapid test in face biometry: set of PAs

- **2D-Photos & Videos on displays**

F18a-d: Tablet	F19a-d: SmartP	
		

3. rapid test in face biometry: set of PAs

- **3D-Models: controlable augmented reality**

  (to counter interactive challenge response PADs)

AR1:	AR2: 3D.AR
	

3. rapid test in face biometry: set of PAs

- **3D-MÂSKS:**
  - **bought: more and more shops offer high quality masks**
  - **self made: new 3D-reconstruction applications and cheap 3D-printers / printing services make high quality masks available for everyone.**

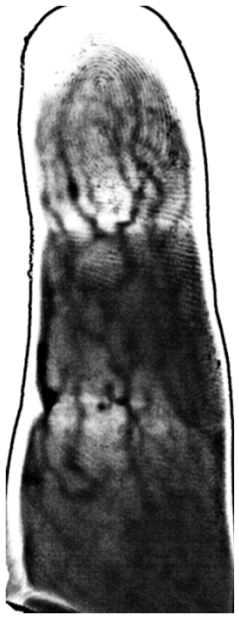
M1:TMF_full	M2: TMF_half	M3: TMF_paper	M4: 3Dprint_#1	M5a-c: Silikon
				

3. rapid test in face biometry: projekt EASYPASS

The German Federal Police is about to install 90 eGates for automated border control on various airports.

- PAD in face biometry was a requirement
- the rapid vulnerability test has been used to support the system development & calibration and for preliminary approval tests before the official test run.
- first results are promising – now comprehensive real world tests are necessary, in order to asses FRR and FAR

4 Outlook



- with the growing importance of biometrics PAD becomes more and more important
- BSI will demand PAD in all future applications
- close international cooperation to develop certification methodologies and standards for all biometric modallities
  (BEAT, ISO SC37 30107, CC…)
- close cooperation with manufactures and ongoing support in their developments

… thank you for listening!

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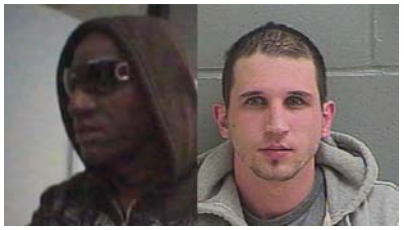
1.3 Gesichts-Biometrie: Masken kommen in Mode



[White man who robbed six banks disguised as a black man faces 35 years in prison]

ARMED RUBBERY

New generation of bank bandits sport expensive, realistic silicone masks

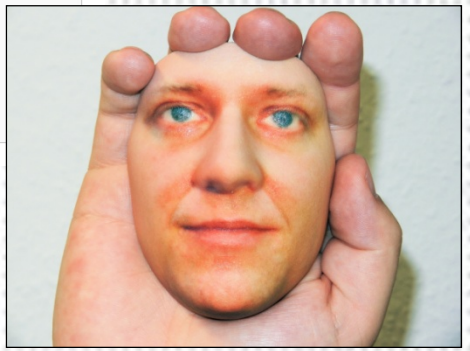
By Andrew Strickler Monday, June 18, 2012

Federal officials suspect this silicone mask, known as "The Elder" and available online for $810, disguised California's infamous "Geezer Bandit," who has robbed at least 16 banks.

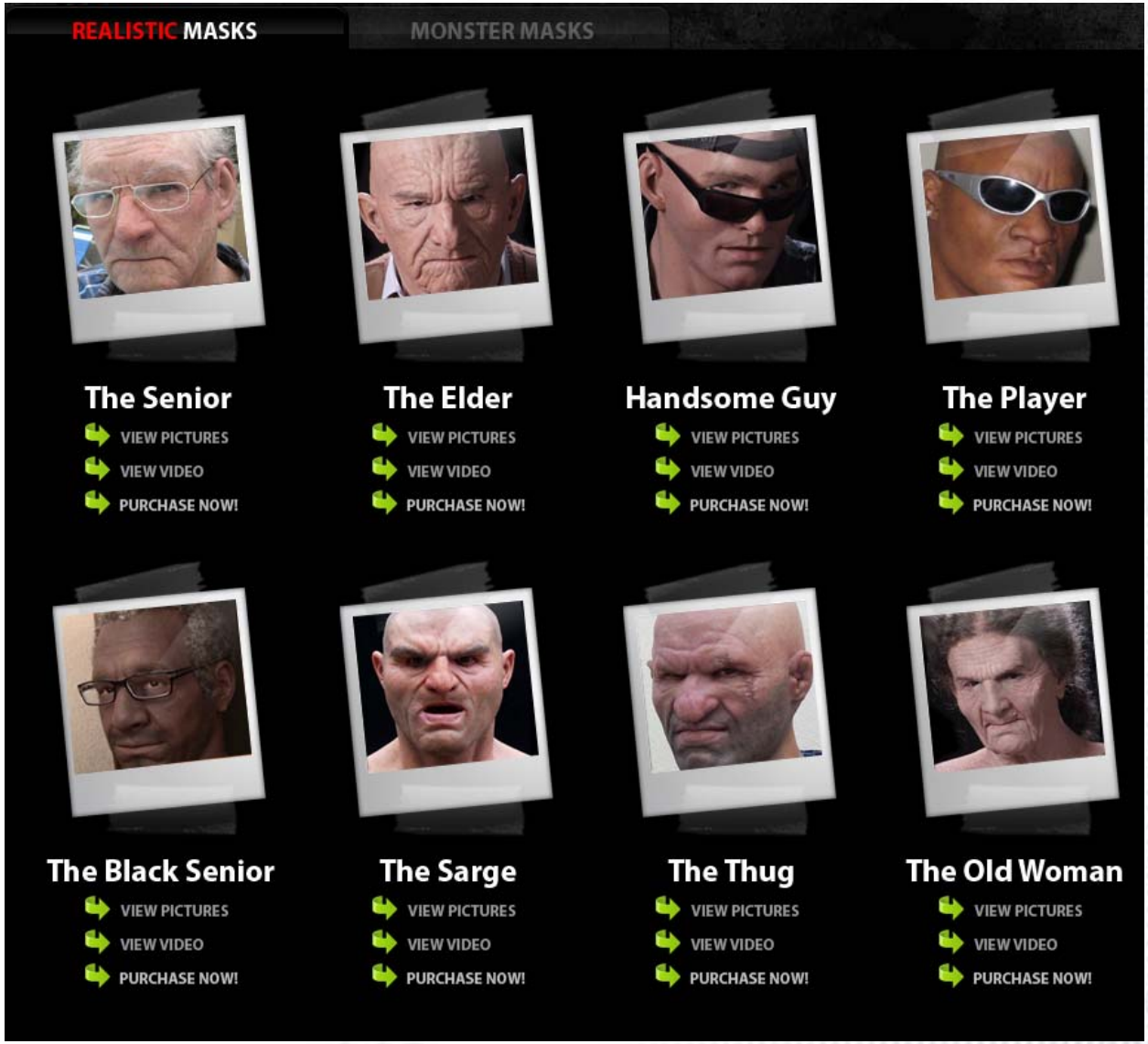
1 of 6

Mask company searched in Geezer Bandit case

1.3 Gesichts-Biometrie: ThatsMyFace.com



1.3 Gesichts-Biometrie: spfxmasks.com



New vendor for HQ-masks: www.compositeeffects.com

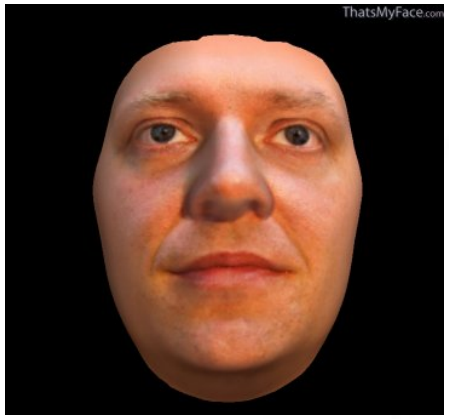
- **special offer:**

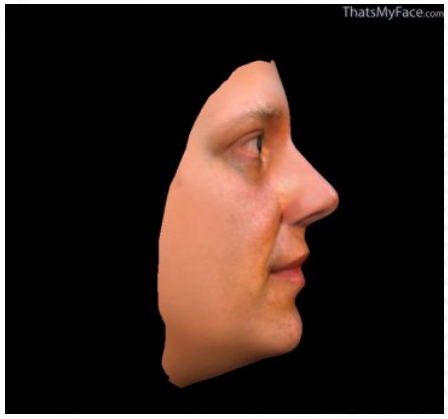
  customized masks

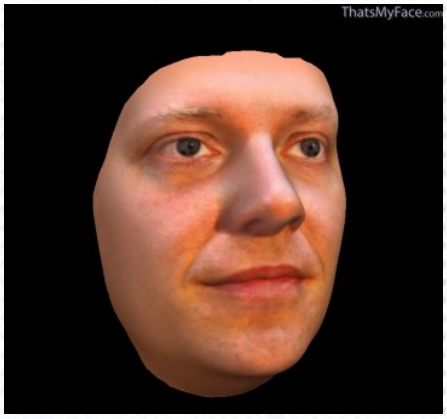
4. Fakes in der Gesichts-Biometrie – gedruckte 3D-Masken

4. Fakes in der Gesichts-Biometrie – gedruckte 3D-Masken

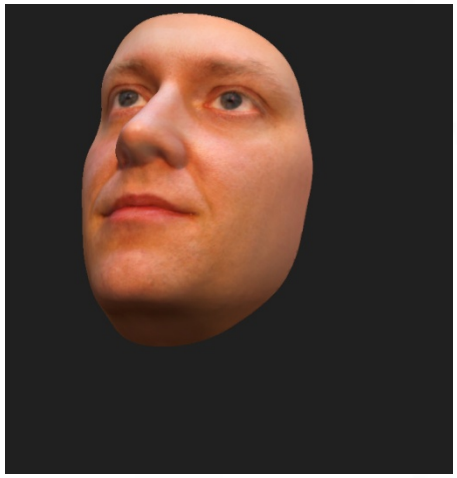
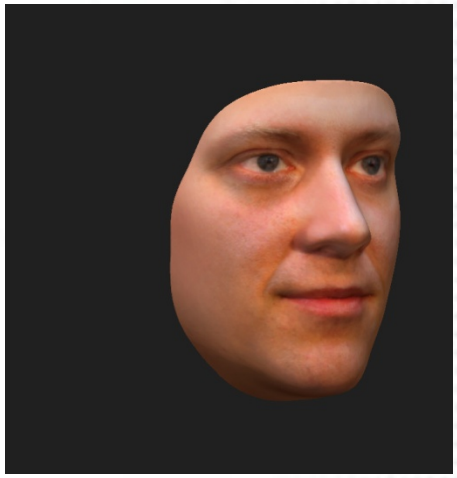
3D-Rekonstruktion:







Produktions-Vorschau:

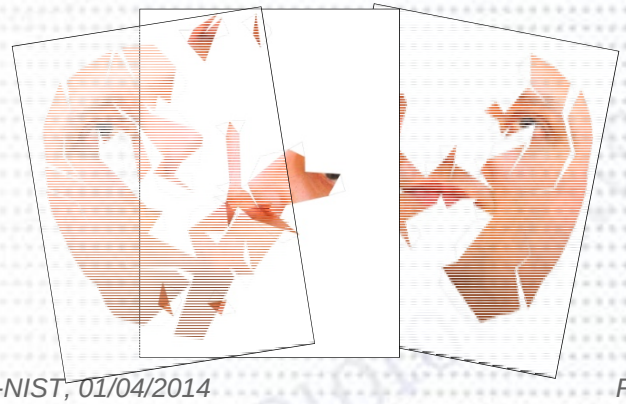

4. Fakes in der Gesichts-Biometrie – gedruckte 3D-Masken

Folgende Test-Masken wurden erworben:

- original-große tragbare Maske (~299$):

- Maske in halber Größe (~199$):

- Papier-Maske (~14$):



1.1 Internationale Kooperation

TABULARASA Trusted Biometrics under Spoofing Attacks
(Wettbewerbe, umfassende Untersuchungen von Angriffen auf Gesichtsbiometrische Systeme) https://www.tabularasa-euproject.org/

INGRESS
Innovative Technology for Fingerprint Live Scanners Entwicklung neuartiger Scanner-technologien für die Finger-Biometrie: Full Field Optical Coherence Tomography (FFOCT) , Printed Organic Electronics (POE) ,Ultraschall Holographie http://www.ingress-project.eu/

B.E.A.T. "Biometrics Evaluation and Testing" zur Standardisierung Evaluationsmethoden von Fake-Erkennungs-Methoden in biometrischen Systemen https://www.beat-eu.org/

FastPass – A harmonized, modular reference system for all European automated border crossing points (für S14 interessant: PAD-competition für Finger, Gesicht & Iris) https://www.fastpass-project.eu/

ISO SC37 Projekt 30107 Biometrics Presentation Attack Detection (PAD)

BVAEG The Biometric Vulnerability Assessment Expert Group was established by the Biometric Institute to raise awareness about the importance of biometric vulnerability assessments and to exchange knowledge and experiences

Ebenso: **Biometrics Institute** (BI), **European Association for Biometrics (EAB)**