Biometric Research in Darmstadt

Christoph Busch

da/sec @ Hochschule Darmstadt

https://christoph-busch.de http://www.dasec.h-da.de

2025-10-01







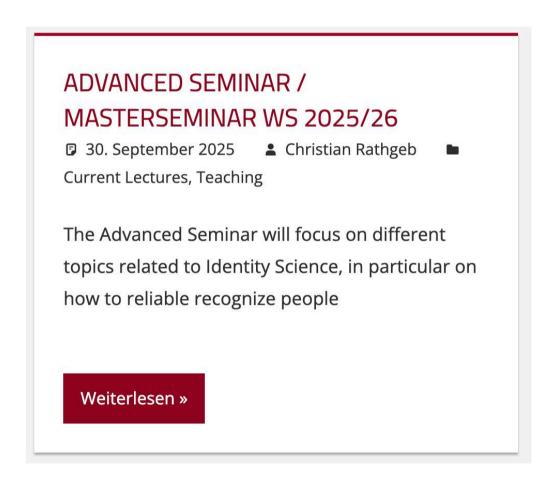


Lectures offered by da/sec

Lectures in WS and SS

We offer the following lecture in the current winter term

https://dasec.h-da.de/category/teaching/lectures_current





Biometrics and Security Research Group da/sec

IT-Security in Darmstadt

National Research Center for Applied Cybersecurity (ATHENE)

400+ scientist from 47+ countries



CYSEC research group at TU Darmstadt





Fraunhofer Institute for Secure Information Technology SIT



Fraunhofer Institute for Computer Graphics Research IGD



da/sec research group at Hochschule Darmstadt





GU Frankfurt

IT-Security in Darmstadt

National Research Center for Applied Cybersecurity (ATHENE)

25 scientist working on biometrics from HDA and Fraunhofer IGD



https://ngbs.athene-center.de/



Research Team

da/sec - Biometrics and Internet-Security Research Group

- Faculty-Members / PostDocs:
 - Christoph Busch
 - Christian Rathgeb
 - Juan Tapia
 - Janier Soler
- PhD-Students / Lab-Engineers:
 - Ana Real
 - Andre Dörsch
 - Daniel Fischer
 - Fabian Stockhardt
 - Florian Bayer
 - Gregor Grote
 - Hans Geißner
 - Robert Nichols
 - Torsten Schlett
 - Philipp Schock



2024

- Key-factors since 2009:
 - 8 European funded projects,
 10 German funded projects
 5 research projects funded by the German BSI,
 2 industrial projects,
 - cooperated with > 30 research partners
 - more than 700 peer-reviewed publications

EU Projects

History of EU-Projects @ HDA

Project Series

FIDELITY

2012-02 to 2016-01

https://christoph-busch.de/projects-fidelity.html

SOTAMD

2019-02 to 2020-01

https://christoph-busch.de/projects-sotamd.html

iMARS

2020-09 to 2024-11

https://christoph-busch.de/projects-iMARS.html

EINSTEIN

2024-01 to 2026-12

https://christoph-busch.de/projects-EINSTEIN.html

CarMen

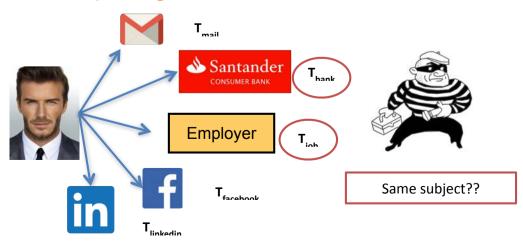
2024-09 to 2027-08

https://christoph-busch.de/projects-CarMen.html

Research Topics

Biometric research

- Covering various biological biometrics:
 - ▶ 2D- and 3D-face recognition,
 - fingerprint recognition,
 - iris and periocular recognition,
- Focus on
 - biometric template protection
 - presentation attack detection
 - morphing attack detection









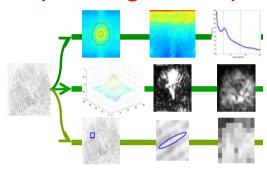


Application Oriented Research

Fingerprint Image Quality Assessment

NFIQ2.0

 Performance improvements can be achieved by improving data quality of biometric references.



 Measure quality by filtering the signal and determine the utility of a fingerprint sample.



Research results constitute the content of ISO/IEC 29794-4

http://www.christoph-busch.de/projects-nfiq2.html

Quality Metrics for Fingerprint Images

NFIQ2.0

Is this (ISO/IEC 29794-4) a relevant standard?

YES - the Entry Exit System implementing decision 2019/329

defines the mandatory use:

• "At the moment of enrolment, the version 2.0 (or newer version) of the Fingerprint Image Quality (NFIQ) metric shall be used for verifying that the quality of the captured fingerprint data respects the thresholds ..."

Official Journal of the European Union COMMISSION IMPLEMENTING DECISION (EU) 2019/329 laying down the specifications for the quality, resolution and use of fingerprints and facial image for biometric verification and identification in the Entry/Exit System (EES) Having regard to the Treaty on the Functioning of the European Union, Having regard to Regulation (EU) 2017/2226 of the European Parliament and of the Council of 30 November 2017 establishing an Entry/Exit System (EES) to register entry and exit data and returnal of entry data of third-country nationals crossing the external borders of the Member States and determining the conditions for access to the EES for law enforcement purposes and amending the Convention implementing the Schengen Agreement and Regulation (EC) No 767/2008 and Regulation (EU) No 1077/2011 (1), and in particular points (a) and (b) of Article 36 first paragraph Regulation (EU) 2017/2226 established the Entry/Exit System (EES) as a system which registers electronically the time and place of entry and exit of third-country nationals admitted for a short stay to the territory of the Member States and which calculates the duration of their authorised stay. The EES aims to improve the management of external borders, to prevent irregular immigration and to facilitate the management of migration flows. The EES should, in particular, contribute to the identification of any person who does not fulfil or no longer fulfils the conditions of the authorised stay on the territory of the Member States, Additionally, the EES should contribute to the prevention, detection and investigation of terrorist offences. As quality and reliability of biometric data are key success factors for EES to reach its full potential, it is necessary As quality and resistually of nometric data are any success stores or tack to track it is null potential, it is necessary to lay down the specifications for the quality, resolution and use of both ingerprists and facial image for blometric verification and identification in the EES, including where taken live or extracted electronically from the electronic Machine Readable Travel Document (softRTD). As the quality or registered fingerprients will have impacts years after registration on the proper functioning of the EES, environmental and operational factors of fingerprint quality registration should be clonely monitored on the long run. This decision does not create any new standards; it is coherent with ICAO standards Based on those measures, the European agency for the operational management of large-scale information systems in the area of freedom, security and justice should then be able to define the design of the physical architecture of the EES including its Communication Infrastructure, as well as the technical specifications of the system and to develop the EES. This Decision is without prejudice to the application of Directive 2004/38/EC of the European Parliament and of the Council (§). is accordance with Articles 1 and 2 of Prosocol No 22 on the position of Denmuk, amened to the Treaty on Intropact Intonia and on the Treaty on the functioning of the European Union, Denmuk did not rate part in the adoption of Regulation (EU) 2017/1226 and is not bound by it or subject to its application. However, given that Regulation (EU) 2017/1226 build upon the Schengea agaita, Denmuk; in accordance with Article 4 of that Protocol, notified on 30 May 2018 its decision to implement Regulation (EU) 2017/1226 in its national law. Denmuk is therefore bound under international law to implement this Device bound under international law in the protection of the pro [7] OJL 327, 9.12.2017, p. 20.
(7) Directive 2004/19816: the European Parliament and of the Council of 29 April 2004 on the right of citizens of the Union and their family members to more and reside feely within the territory of the Member States amending Regulation (EEC) No 1612/64 and repealing Directives 64(22):EEC, 65(360)EEC, 72(194)EEC, 73(144)EEC, 75(15)EEC, 75(15)EEC, 79(164)EEC, 79(165)EEC, 40(165)EEC, 79(164)EEC, 79(164)EEC, 75(165)EEC, 79(164)EEC, 7

http://www.christoph-busch.de/projects-nfiq2.html

Image Quality in the EU Entry Exit System

The objective in the EES implementing decision 2019/329

 "The quality of the facial images, … and with the image requirements of ISO/IEC 19794-5:2011 Frontal image type"

What does that mean?

Data subjects need actionable feedback

If quality is poor, then what went wrong?

INTERNATIONAL STANDARD

ISO/IEC 19794-5

> Second edition 2011-11-01

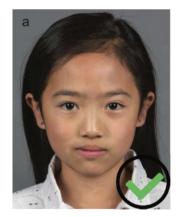
Information technology — Biometric data interchange formats —

Part 5:

Face image data

Technologies de l'information — Formats d'échange de données biométriques —

Partie 5: Données d'image de la face



Compliant image



Pose



Eyes open



Mouth open



Inhomogenous background

Source: ISO/IEC 39794-5

ISO/IEC 29794-5: Face Image Quality

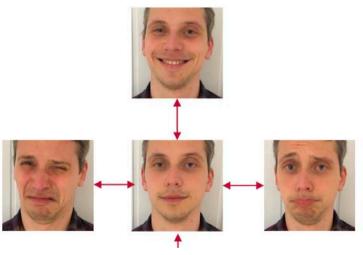
Standardize and develop quality measures

- https://www.iso.org/standard/81005.html
- https://github.com/BSI-OFIQ/OFIQ-Project
- https://christoph-busch.de/projects-ofiq.html
- Unified quality score
- Capture-related quality measures
- Subject-related quality measures
- Contribution from our research:
 - Quantify expression neutrality





a) Compliant image b) Low contrast source: ISO/IEC 39794-5:2019, Annex D



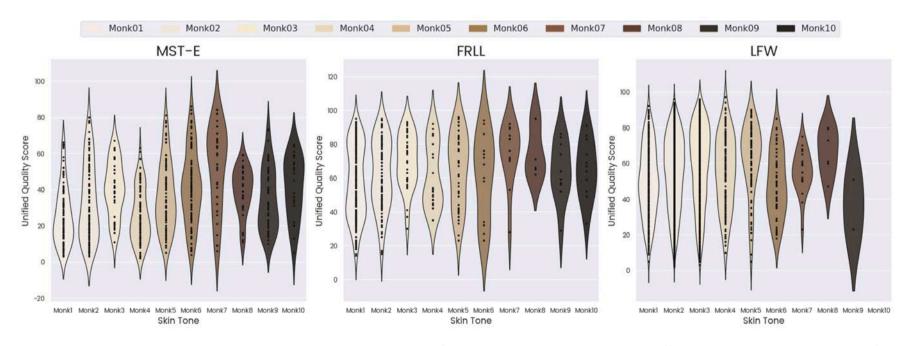
[GRVB2023] M. Grimmer, C. Rathgeb, R. Veldhuis, C. Busch: "NeutrEx: A 3D Quality Component Measure on Facial Expression Neutrality", in Proceedings of International Joint Conference on Biometrics (IJCB), (2023)

[GVB2024] M. Grimmer, R. Veldhuis, C. Busch: "Efficient Expression Neutrality Estimation with Application to Face Recognition Utility Prediction", in Proceedings of 12th International Workshop on Biometrics and Forensics, (2024)

Face Image Quality - Future work

Open research tasks for OFIQ 2

- Further innovation of quality measures
- Add missing components (e.g. motion blur)
- Investigate demographic variability
 - Unified quality score distributions across MST 10 skin tone scale

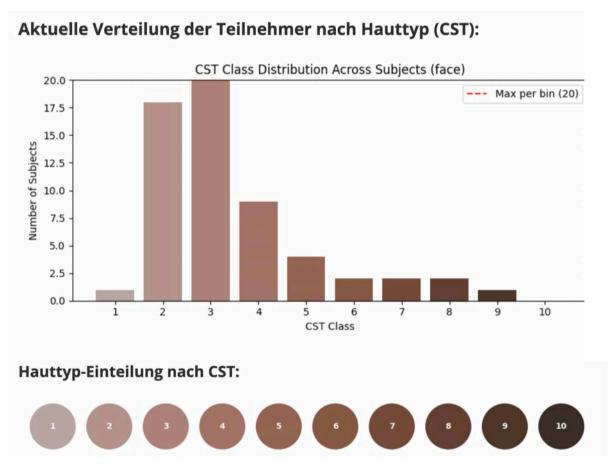


[KRRB2024] W. Kabbani, K. Raja, R. Raghavendra, C. Busch: "Demographic Differentials in Face Image Quality Measures", in Proceedings of the IEEE 23rd International Conference of the Biometrics Special Interest Group (BIOSIG), Darmstadt, September 25-27, (2024)

Face Image Quality - Future work

Darmstadt Skin Tone Database

https://dasec.h-da.de/research/biometrics/hda-passport-fairness-database/





European Association for Biometrics (EAB)

Objectives of the EAB

- The EAB is a non-profit, nonpartisan association https://eab.org/
- EAB supports all sections of the ID community across Europe, including governments, NGO's, industry, associations and special interest groups and academia.





- Our role is to promote the responsible use and adoption of modern digital identity systems that enhance people's lives and drive economic growth.
- Free membership for Bachelor, Master and PhD students!
 https://eab.org/membership/types_of_membership.html

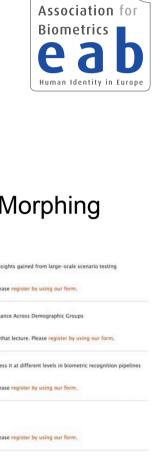
European Association for Biometrics (EAB)

More Information

- Our initiatives are designed to foster networking
 - annual conference: EAB-RPC https://eab.org/events/program/300
 - research awards https://eab.org/award/hall of fame.html
 - workshops on relevant topics (e.g. Presentation Attack Detection, Morphing Attack Detection, Sample Quality, Bias in Biometric Systems)

https://eab.org/events/

- lunch talks https://eab.org/events/program/324
- recorded keynote talks https://eab.org/events/lectures.html
- monthly newsletter https://eab.org/news/newsletter.html
- annual academic graduation report https://eab.org/information/documents.html
- open source repository https://eab.org/information/software.html



Demographic differentials in face recognition algorithm

ou may want to become a member in order to see that lecture. Please register by using our form

European

Contact





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