Standardization - ISO/IEC 29794-4
Mapping NFIQ 2.0 quality components to impairments

Martin Aastrup Olsen, Christoph Busch
da/sec – CASED, Hochschule Darmstadt, Germany
Outline

- Overview
  - ISO/IEC 29794-4 Overview & Status
  - Quality Features
  - 29794-4 Finger Image Defect Categories
  - NFIQ 2.0 - Mapping Quality to Defects
  - Features as flags
  - Dissemination
ISO/IEC 29794-4 Overview & Status

- Information technology - Biometric sample quality - Part 4: Finger image data
- Project under ISO/IEC JTC/1 SC/37 WG/3
- Establishes methods to quantify quality
  - Specifies equations and algorithms for quality assessment of finger images
- Currently 3rd working draft
  - commenting period until May 12
  - revision in July
Quality Features currently in 29794-4

- Global and local features
  - Orientation Certainty Level
  - Local Clarity Score
  - Frequency Domain Analysis
  - Gabor
  - Radial Power Spectrum
  - Orientation Flow

- ... more to be added subject to approval by the WG

- Same strategy as in part 6 on iris image quality
  - Required image quality metrics (e.g. NFIQ 2.0 subset)
  - Recommend image quality metrics (others)
Defects listed in 29794-4 (Annex B)

1. Defect caused by user character
   A. Extreme skin conditions such as very wet, very dry, etc.
   B. Scars
   C. Wrinkles
   D. Blisters
   E. Eczema
   F. Impurities such as dirt, latent print, etc.

2. Defect caused by imaging
   A. Sampling error
   B. Low contrast or signal-to-noise ratio
   C. Distortion
   D. Erroneous or streak lines
   E. Uneven background
   F. Insufficient dynamic range
   G. Non-linear or non-uniform grayscale output
   H. Pixels not available due to hardware failure
   I. Aliasing problems

3. Defect caused by user behavior
   A. Elastic deformation
   B. Improper finger placement such as too low, rotated, etc.
   C. Insufficient area of finger image

4. Defect caused by environment
   A. Humidity
   B. Light
   C. Impurities on the scanner surface such as latent prints
Actionable Quality

- Quality scores convey information about expected biometric performance
  - Low score -> high likelihood of FNM
- Sample rejected due to low quality – what to do?
  - Provide feedback to the user in a way that is actionable
- An interpretation of the quality score
- Some aspects have been addressed by Maltoni, Ferrara
  - Effects of area
  - Sensor sharpness
- Several issues
  - No ground truth data available
  - How to quantify the defects
Centeredness of fingerprint

- Position of core (C) relative to center of foreground (O)
- Distance between (C) and (O) determines centeredness of fingerprint
- Limited relationship between centeredness and biometric performance
- Results: “Finger image quality based on singular point localization”, Jinghua Wang, Martin A. Olsen and Christoph Busch, SPIE D+S 2014 (to appear)
Mapping Quality to Defects

- **Categories**
  - Small Area (AR)
  - Ghost impression (GH)
  - High pressure (PH)
  - Low pressure (PL)
  - Excessive scarring (SC)
  - Unsharp image (US)

- Manual inspection of 1000+ samples causing FNM at FMR=$10^{-4}$
  - 457 Labels assigned to 382 images
  - Data from operational environments
Features as Flags – First steps

- Relationship between features and manually assigned labels

  - Ghost impression (GH)
  - High pressure (PH)
  - Low pressure (PL)

  - Samples involved in comparisons receiving highest comparison scores (1)
  - Samples involved in comparisons giving FNM at FMR=10^{-4} (0)
Wetness and Pressure as a Flag

- Fingerprints acquired when wet or when pressed against the platen exhibit similar characteristics (e.g. ridges merging).

- Collected dataset
  - 6600 samples, 33 subjects, 5 sensors, 4 treatments: normal, dry, lotion and water
  - Objective measurement of moisture level prior to acquisition
  - Further information https://www.dasec.h-da.de/wdset02

(a) dry 62.5%  
(b) normal 84.6%  
(c) wet 99.9%  
(d) pressure 84.6%
Features as Flags – Continued

- Quality score in relation to objective measurements (WDSET02)
Application Context

- The flag should be a guide to potential defects
  - Application dependent and in context of quality score
- Possible profiles
  - IF centeredness_flag
    - Recapture
  - IF wetness_flag AND qscore < T
    - Recapture
Dissemination as International Standard

- Results from development will be included in ISO/IEC rev 29794-4:201x "Information technology - Biometrics sample quality Part 4: Finger image data"
- Input desired on support for metrics (known failures)
- Quality feature classes
  - Global features
  - Local features (blockwise)
- Expected return of research investment
  - Revision of ISO/IEC IS 29794-4:201x
  - Upgrade to an IS (International Standard)
- Currently at 3rd working draft
Contact

da/sec - CASED, Hochschule Darmstadt

Martin Aastrup Olsen
martin.olsen@cased.de
https://www.cased.de

Christoph Busch
christoph.busch@h-da.de
https://www.dasec.h-da.de/

Dataset: https://www.dasec.h-da.de/wdset02

http://www.nist.gov/itl/iad/ig/development_nfiq_2.cfm