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

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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

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- 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

TECHNICAL
REPORT

ISO/IEC
TR
29794-4

First edition
2010-04-01

Information technology — Biometric
sample quality —

Part 4:
Finger image data

Technologies de l'information — Qualité d'échantillon biométrique —
Partie 4: Données d'image de doigt

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)
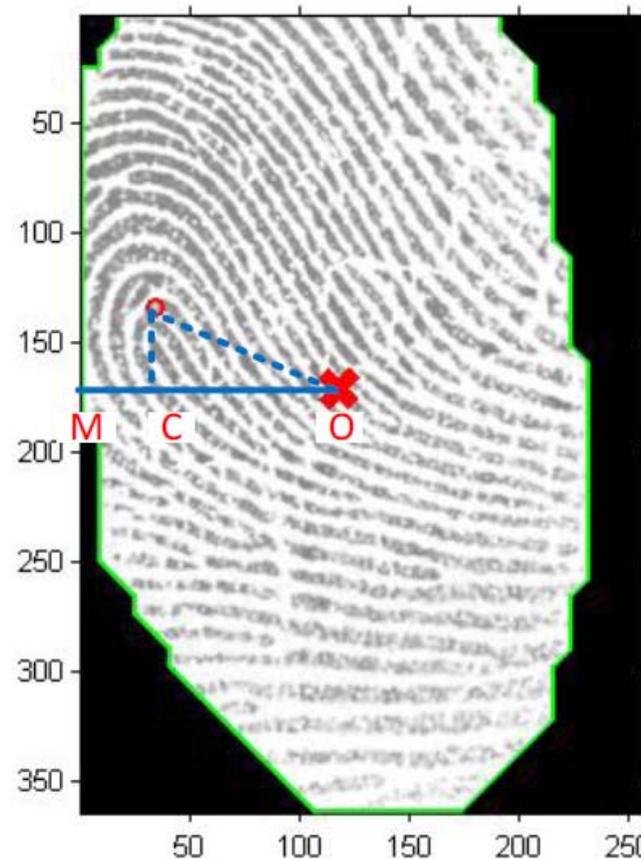
Mapping Quality to Defects

- Categories
    - Small Area (AR)
    - Ghost impression (GH)
    - High pressure (PH)
    - Low pressure (PL)
    - Excessive scarring (SC)
    - Unsharp image (US)
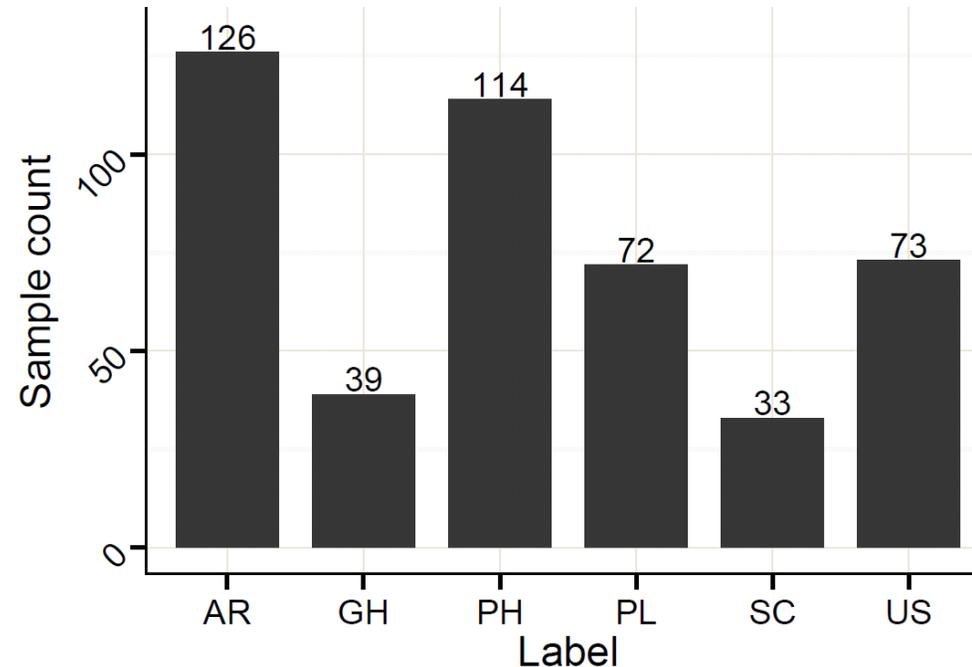
- Manual inspection of 1000+ samples causing FNM at FMR=10^-4
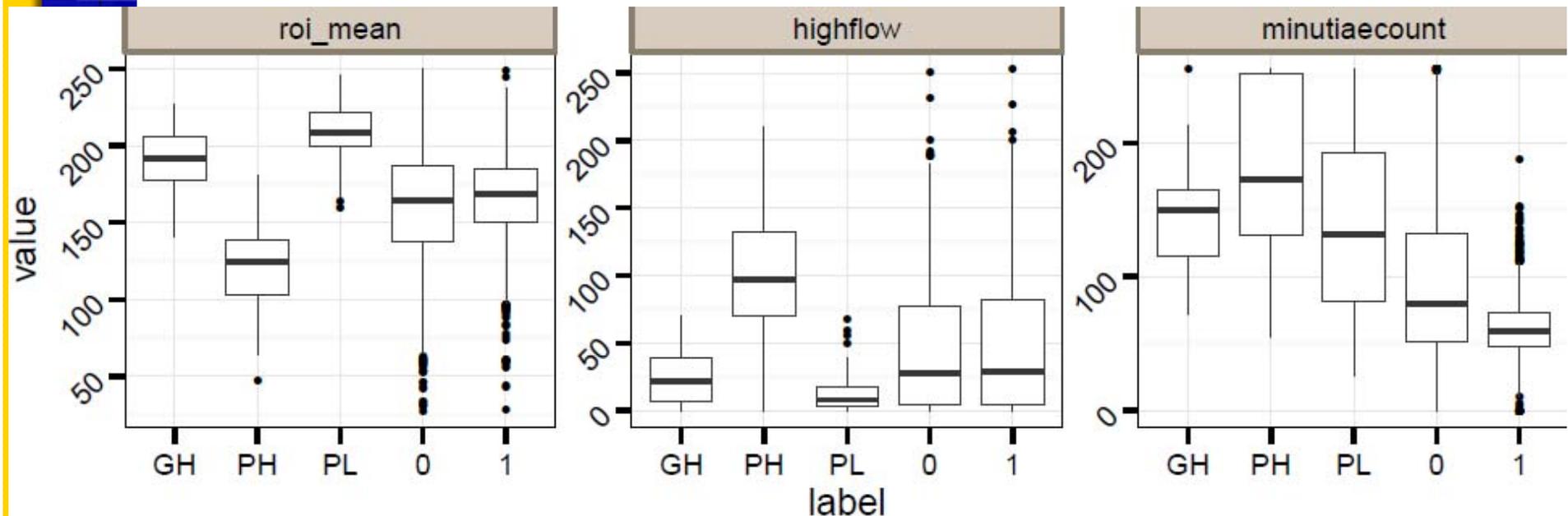   - 457 Labels assigned to 382 images
    - Data from operational environments

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
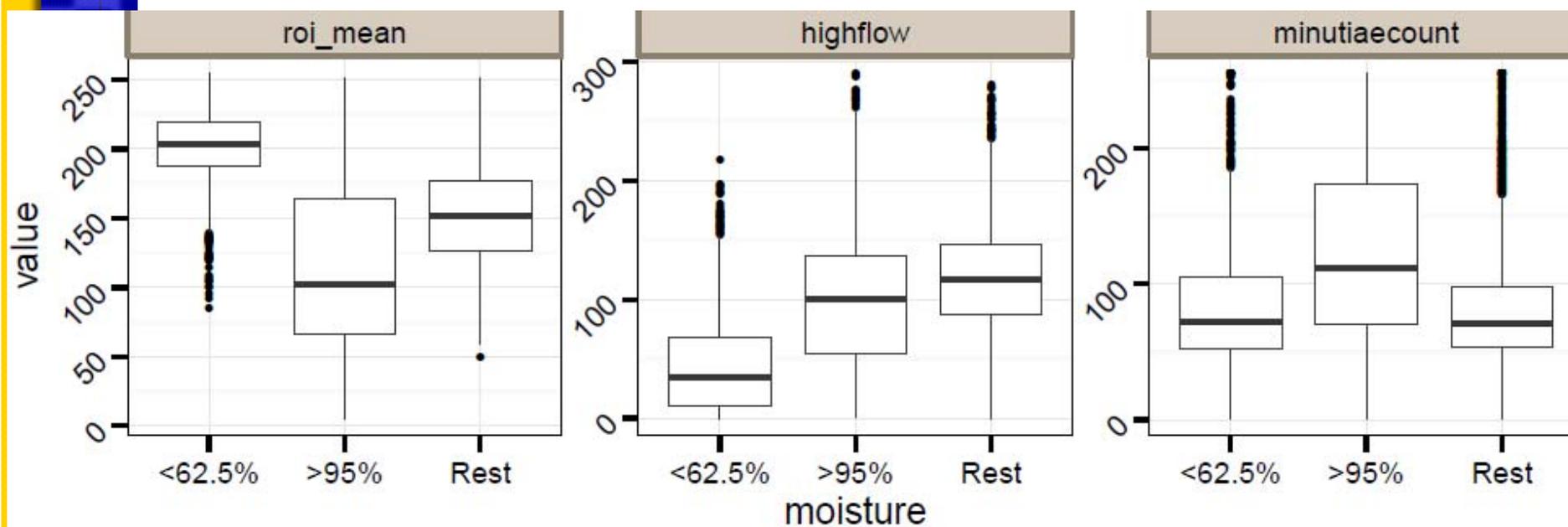

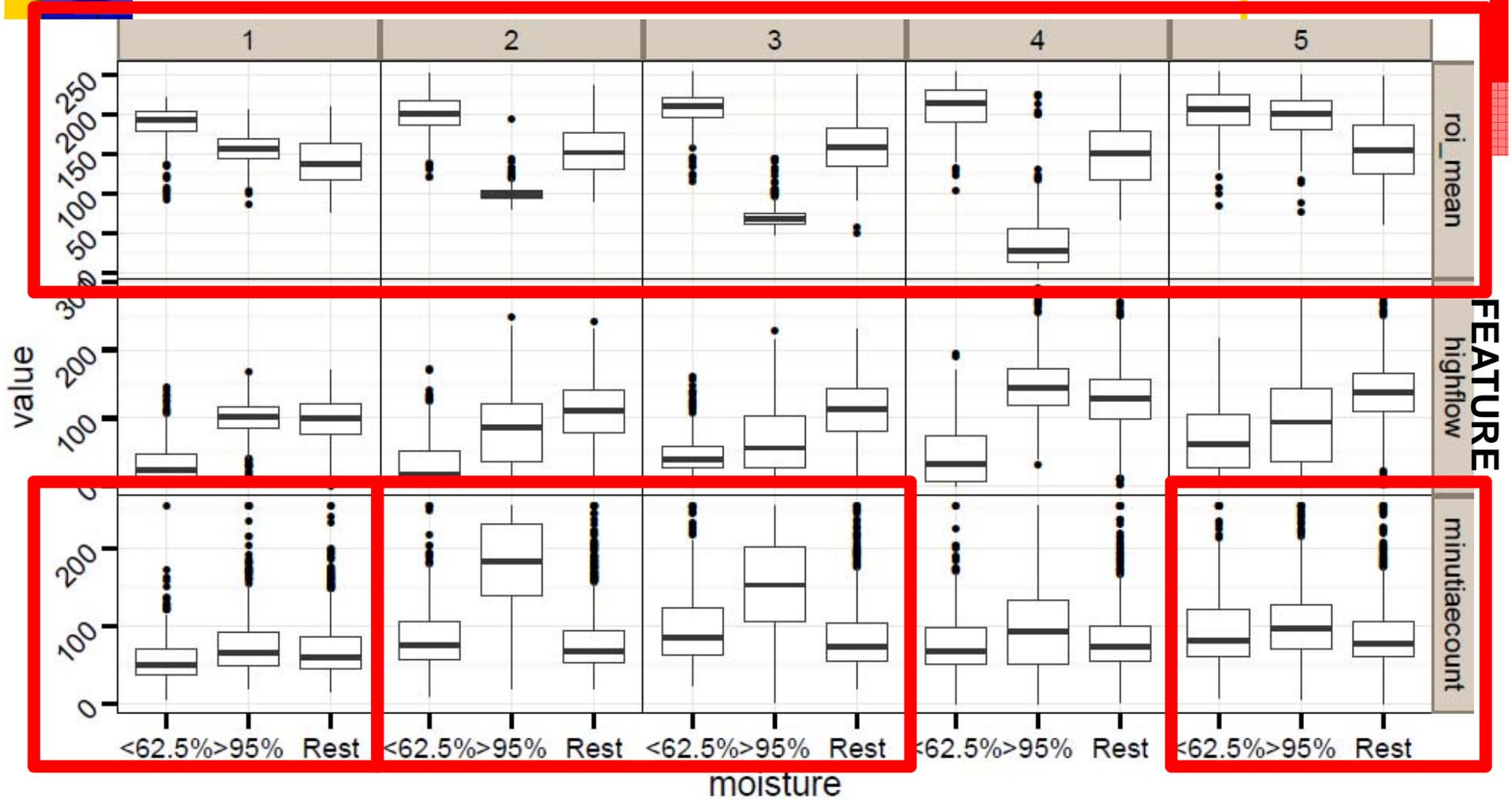| (a) dry | (b) normal | (c) wet | (d) pressure |
| 62.5% | 84.6% | 99.9% | 84.6% |

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

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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

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

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