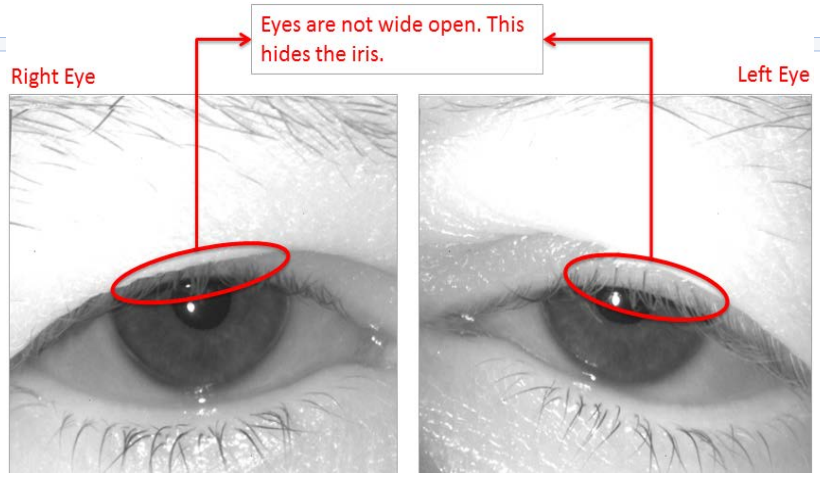
Iris Quality Standardization

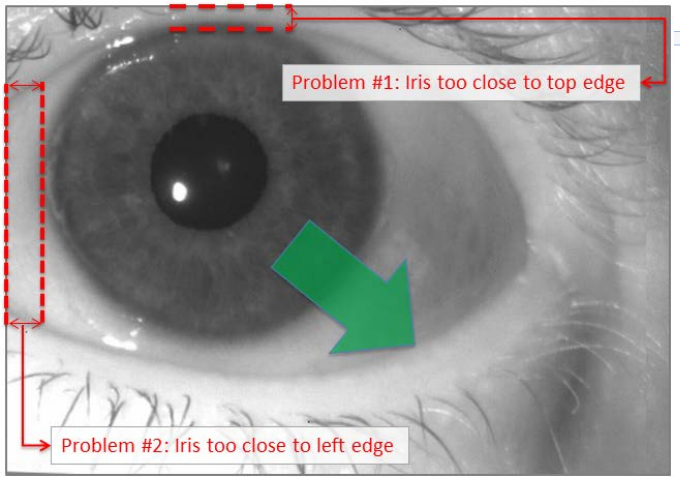
Elham Tabassi

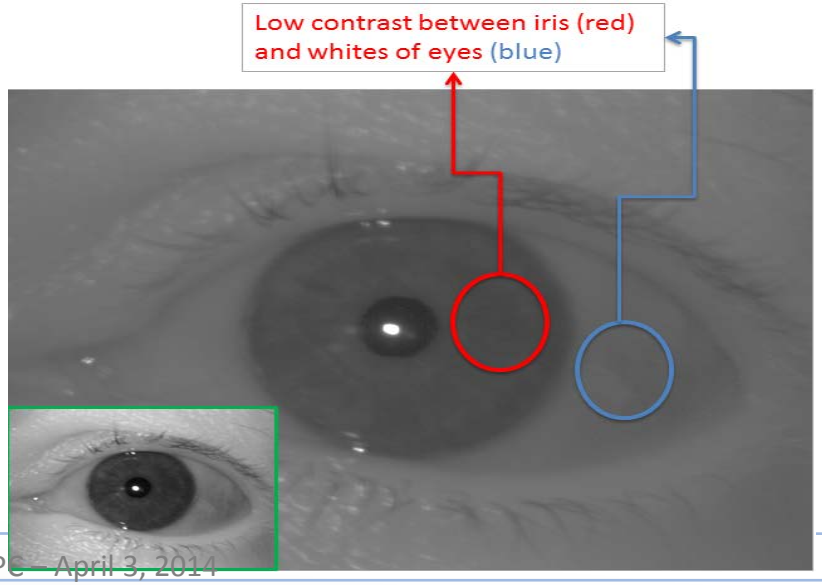
Role of Standards

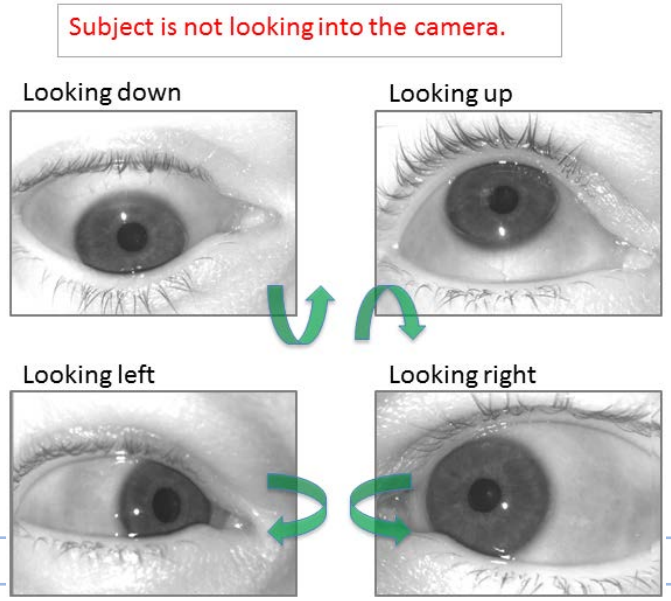
- Open specifications for iris cameras, iris image properties (quality) and iris image record.
- Prevent vendor lock-in.
- Allows for a marketplace of off-the-shelf product.
- Allows modular integration of products without comprising architecture scope.
- Allows for performance improvement (quality by design)
  - Prevent GIGO

Prevent GIGO

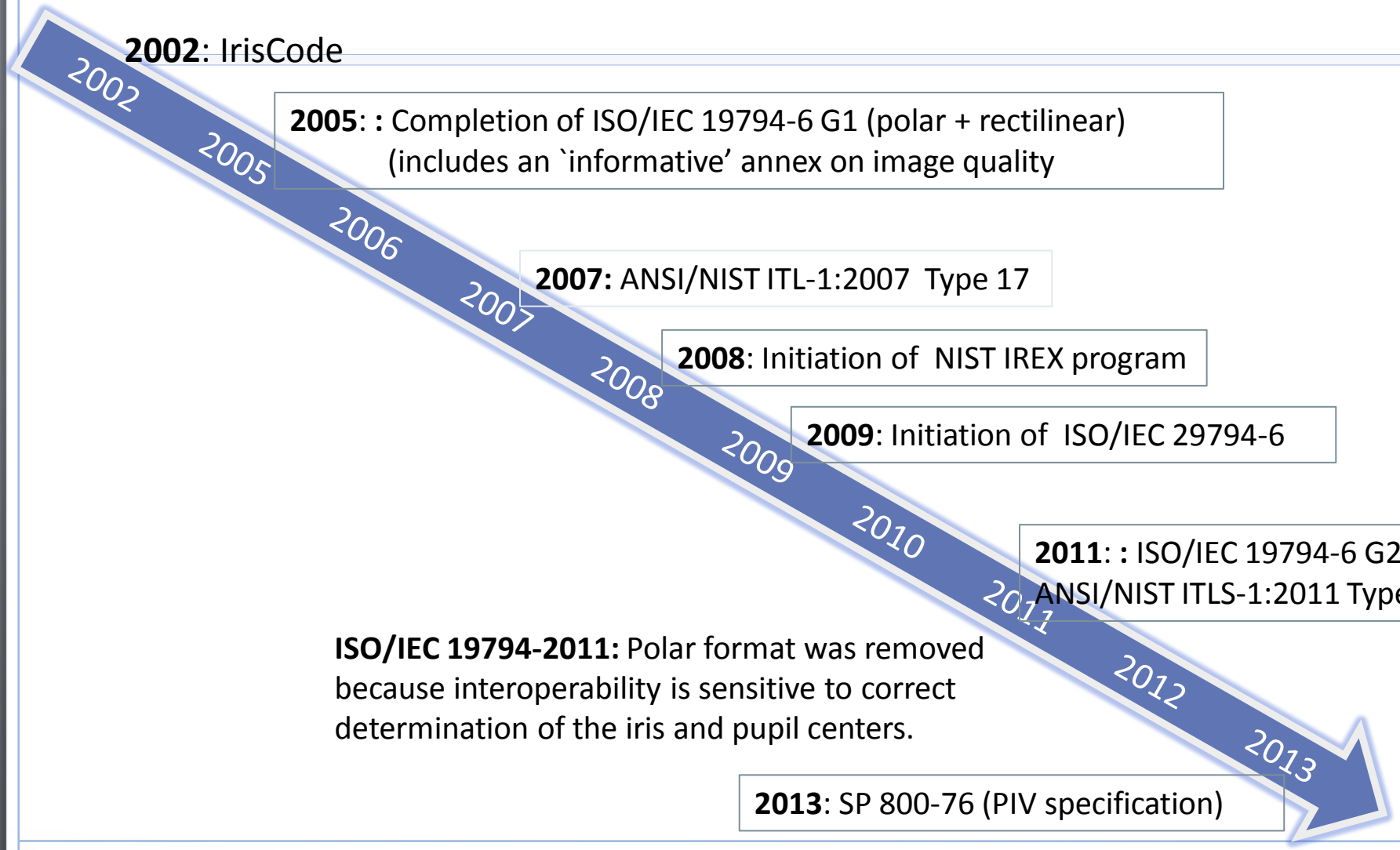








History



2002: IrisCode

2005: **:** Completion of ISO/IEC 19794-6 G1 (polar + rectilinear)
(includes an `informative' annex on image quality

2007: ANSI/NIST ITL-1:2007 Type 17

2008: Initiation of NIST IREX program

2009: Initiation of ISO/IEC 29794-6

2011: **:** ISO/IEC 19794-6 G2
ANSI/NIST ITLS-1:2011 Type 17

ISO/IEC 19794-2011: Polar format was removed because interoperability is sensitive to correct determination of the iris and pupil centers.

2013: SP 800-76 (PIV specification)

Subcommittee 37 “Biometrics”

JTC 1 SC37 ISO/IEC 19794

- Biometric data interchange format
  - Goal: interoperability
    - Avoid vendor lock-in
- Multipart standard
  - Part 6: Iris image : Published 2011-09-29
  - Part 1: Framework
  - Parts 2(finger minutiae), 4(finger image), 5(face image), etc.

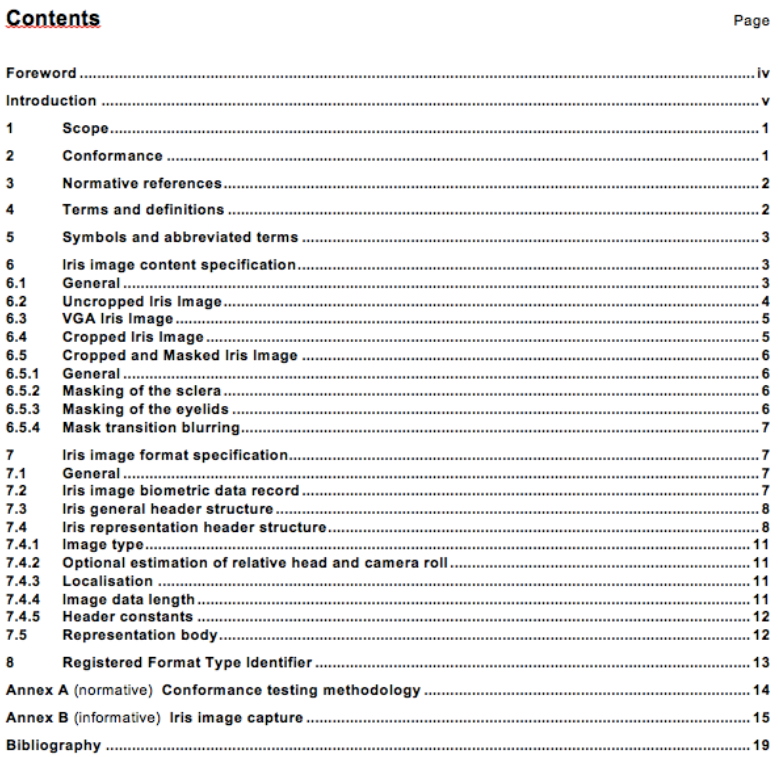
JTC 1 SC37 ISO/IEC 29794

- Biometric sample quality
  - Goal: interoperable performance
    - Avoid vendor lock-in
    - Avoid GIGO
- Multipart standard
  - Part 6: Iris image: Expected 2014
  - Part 1: Framework
  - Part 4(finger image) + Technical Report Part 5(face image).

ISO/IEC 19794-6

Biometric data interchange format – Part 6: Iris image

- specifies iris image interchange formats for biometric enrolment, verification and identification systems.
  - Image format
  - Compression format for size constrained applications
- Out of scope
  - requirements on the optical specifications of cameras, photometric properties of iris images, enrolment processes, workflow and use of iris equipment.
- AMD 1: Conformance Testing



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ISO/IEC 29794-6

Biometric sample quality – Part 6: Iris image

- Defines and quantifies iris image quality components.
  - for a single image,
  - for two images being compared, and
  - for acquisition device.
- Considers subject, environment and device covariates.
- For each quality component, it specifies
  - description, computation method, units, and valid values/threshold.

Table of contents

IQCE :: Quantitative support

- The 2nd activity under irex IRIS EXCHANGE
- Funded by DHS S+T
  - Project “Radical improvement in iris quality assessment and maturing multimodal biometric utilization”
- An evaluation based program for development of clear, implementable, and interoperable iris quality standard ISO/IEC 29694-6.
  - To establish requirements on software or hardware capturing iris image
    - A refined list of image properties affecting iris recognition performance
  - To established requirements on iris image covariates

IREX II - IQCE

Iris Quality Calibration and Evaluation

Performance of Iris Image Quality Assessment Algorithms

NIST Interagency Report 7820

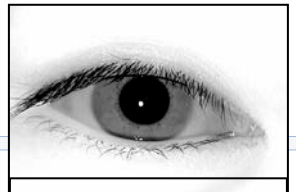
E. Tabassi, P. Grother, and W. Salamon

Information Access Division
National Institute of Standards and Technology

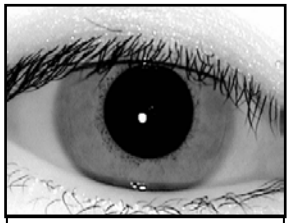
NIST

September 30, 2011

IQCE



raw image



Cropped

VENDOR SUPPLIED IMAGE QUALITY ASSESSMENT ALGORITHM (IQAA)

QUALITY VECTOR

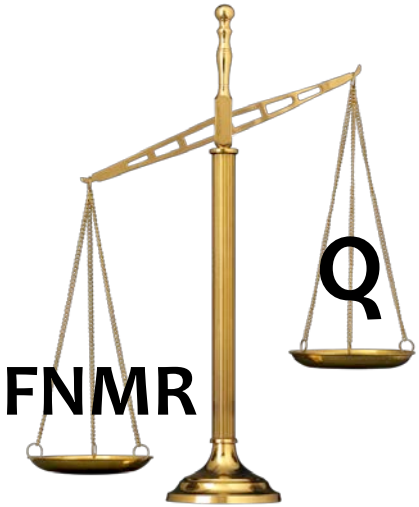


Table 4. IQAAs output format.

The range of each metric shall be [0,254], a value of 255 means that the quality metric is not computed.

Position	Metric
1	Scalar overall quality
2	Gray level spread
3	[illegible]dius in pixel)
4	Pupil iris ratio (ratio of pupil diameter over iris diameter)
5	[illegible]
6	Iris-sclera contrast
7	Iris-pupil contrast
8	[illegible]sclera boundary shape (iris shape)
9	Iris pupil boundary shape (pupil shape)
10	Margin (image scale in N3331)
11	[illegible]
12	Motion blur
13	Signal to noise ratio
14	Magnification
15	Head rotation
16	Gaze angle
17	Interlace
18- 32	Reserved for future standardized quality metric
33 ... 64	Vendor-defined quality measurements

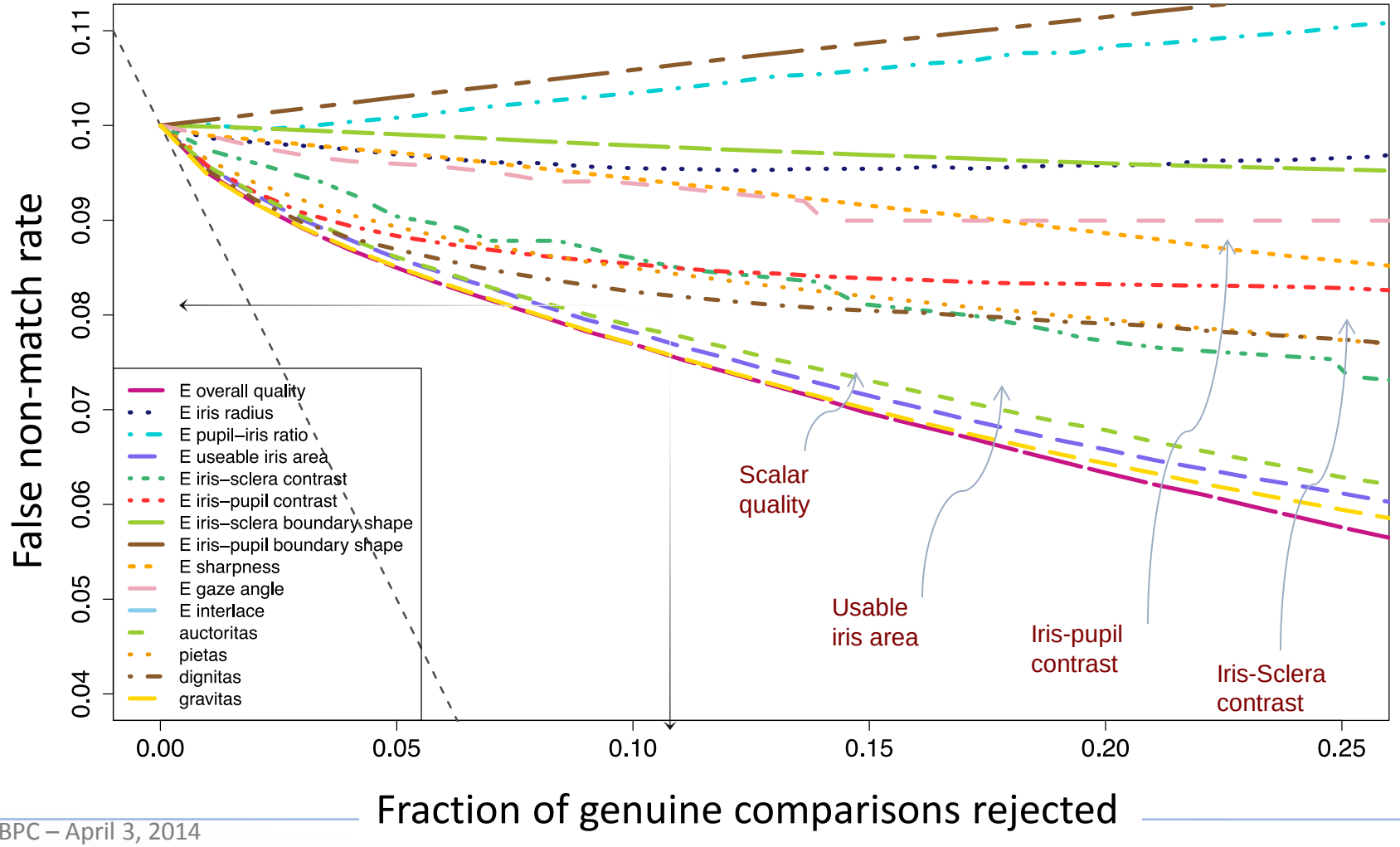
1 **Scalar quality**

2 .. 17 **Defined (standard) quality metrics**

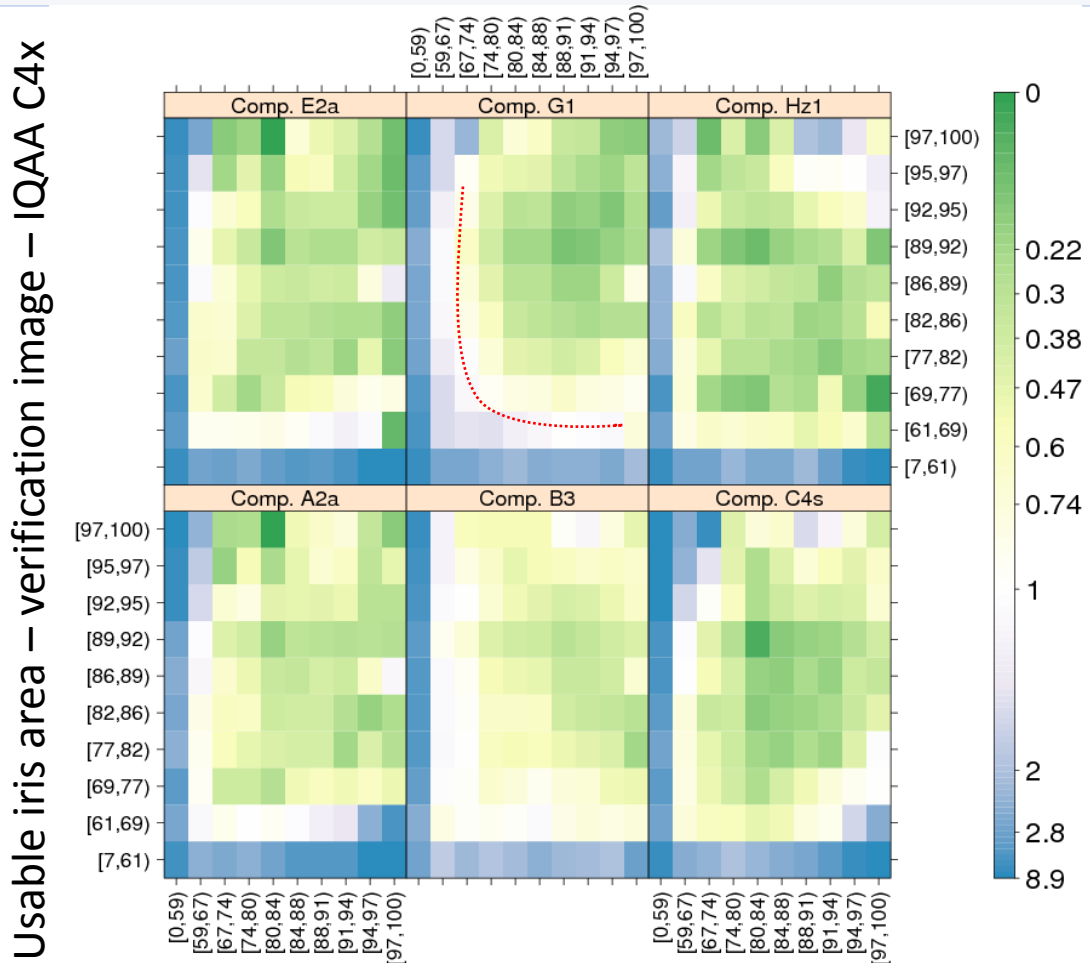
18..32 **Reserved**

33..64 **Vendor-defined quality metrics**

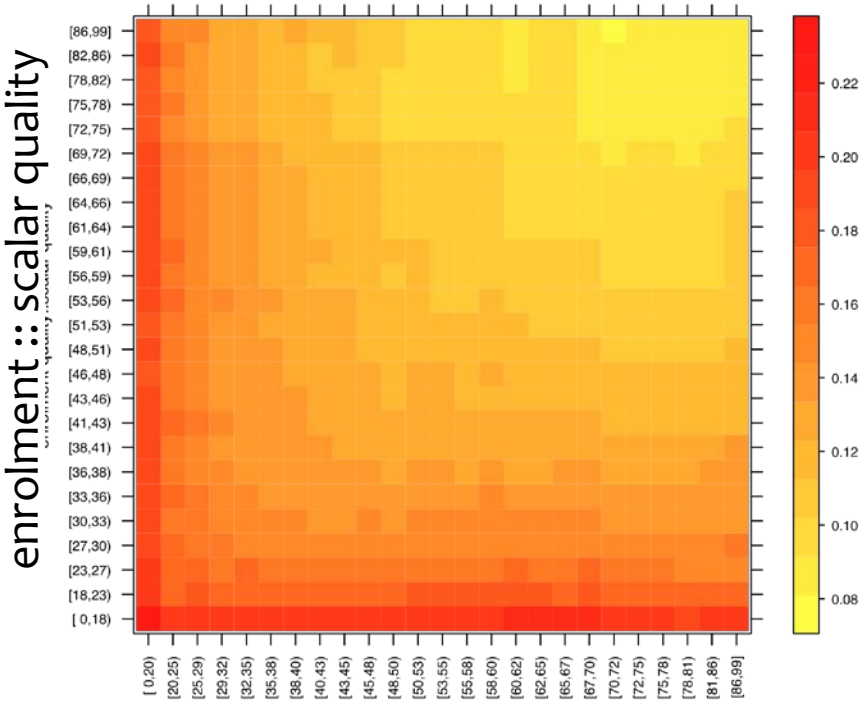
IQCE:: determining factors affecting iris recognition performance



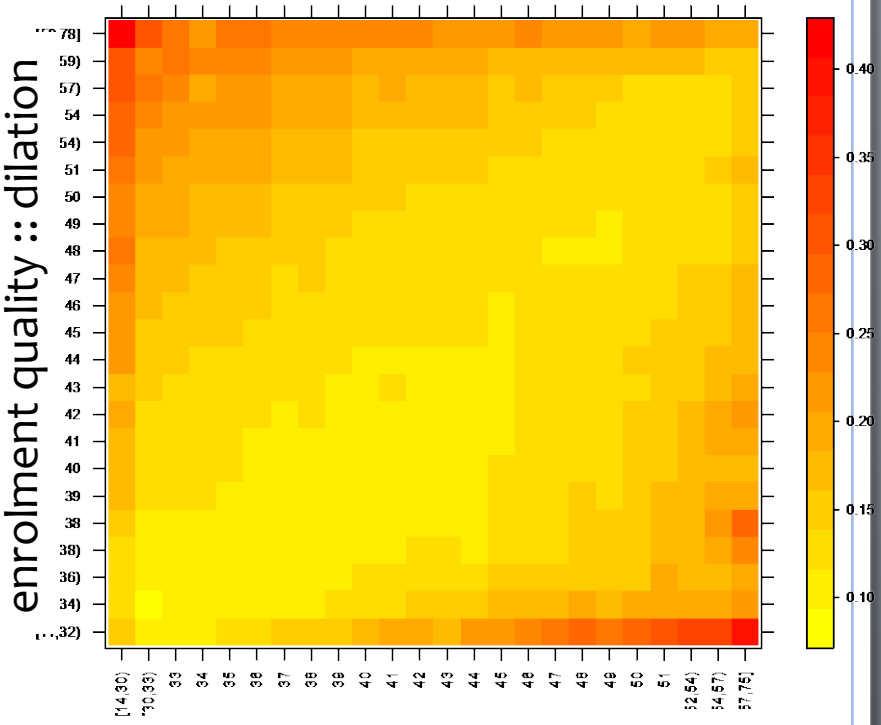
IQCE:: determining requirement (Ex. usable iris area)



Mutual quality :: How similarity of quality between two images being compared affects performance?



Verification :: scalar quality



verification quality :: dilation

Image quality components

Required

1. Usable iris area [70,100]
2. Iris-sclera contrast [5,100]
3. Iris pupil contrast [30,100]
4. Pupil boundary circularity
5. Grey scale utilisation [6,20]
6. Iris radius [80,253]
7. Pupil iris ratio [20,60]
8. Iris pupil concentricity [90,100]
9. Margin adequacy [80,100]

Recommended

10. Sharpness
11. Frontal gaze-elevation
12. Frontal gaze-azimuth
13. Motion blur

Mutual quality

- Illumination similarity
  - Camera interoperability
- Common usable iris area
- Dilation constancy

Camera quality components

- Dedicated illumination

$$\frac{\int_{700}^{900} P(\lambda)d\lambda}{\int_{680}^{920} P(\lambda)d\lambda} \geq 0,9$$

$$\frac{\int_{700}^{800} P(\lambda)d\lambda}{\int_{700}^{900} P(\lambda)d\lambda} \geq 0,35$$

$$\frac{\int_{800}^{900} P(\lambda)d\lambda}{\int_{700}^{900} P(\lambda)d\lambda} \geq 0,35$$

- Modulation transfer function
  - modulation of more than 50% at 1lp/mm using appropriate targets.
- Optical distortion
- Pixel aspect ratio
  - between 0.99 and 1.01.
- Sensor signal-to-noise ratio
  - larger or equal to 36 dB.
- Spatial sampling rate
  - at least 15.7 pixel/mm.

Status

Time line

- Is balloted for Draft International Standard.
- Open issues:
  - Computation methods for sharpness, gaze angle
  - Computation method for unified quality score

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Thank You.

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IREX (Iris Exchange)

NIST's umbrella program for iris recognition performance, standards, and image-based interoperability

IREX I	IREX II / IQCE	IREX III	IREX IV	IREX V	IREX VI	IREX VII
Accuracy of compact iris images in support of the ISO/IEC 19794-6 and ANSI/NIST Type 17 standards	Image quality definition, evaluation, calibration supporting the ISO/IEC 29794-6 standard	One-to-many Iris recognition - Single and two-eye accuracy and resource requirements	Minimum error (weighted FNIR + FPIR) one-to-many recognition; Rapid ID compression profiles	Instructional and guidance materials for image collection	Temporal dependence, Iris aging, template aging, longitudinal effects.	Abstraction layers Encapsulating core iris processing functions
2008-2009	2010-2011	2011-2012	2012	2012-2013	2012-2013	2013-
Test	Test	Test	Test	Best Practice Documents	Test	Best Practice Documents

irex

IRIS EXCHANGE

Technical Approach