



# Iris Quality Standardization

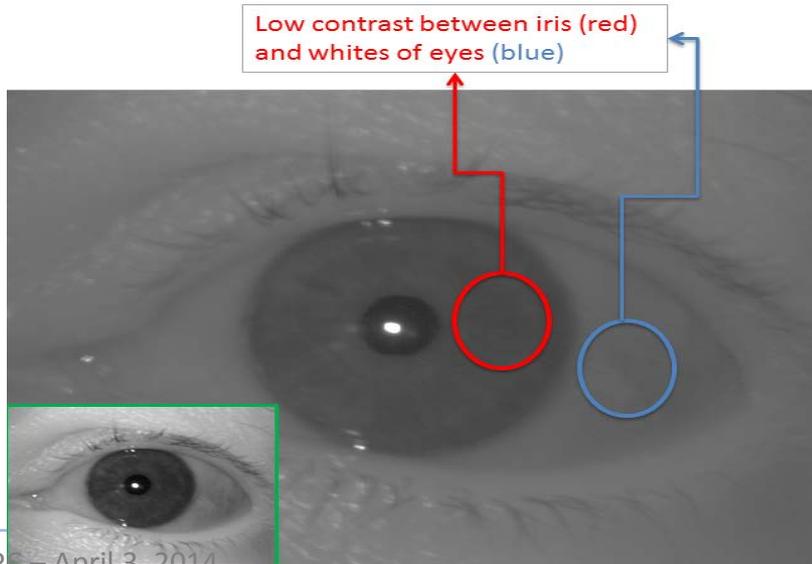
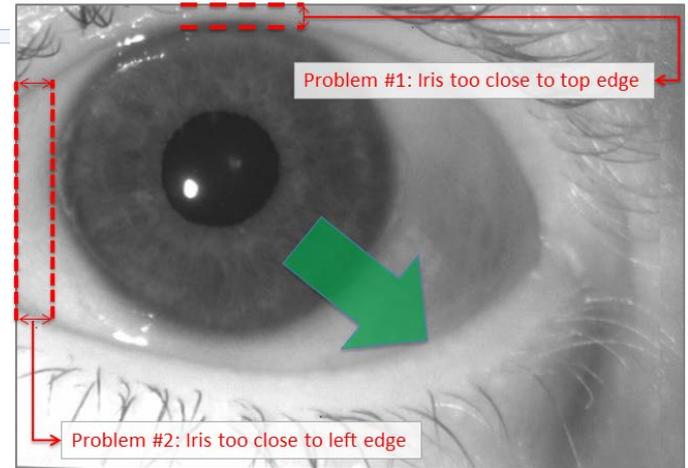
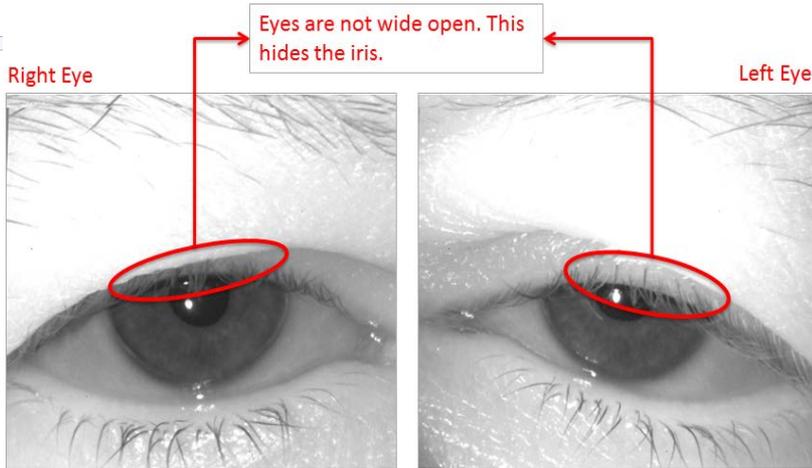
Elham Tabassi



# Role of Standards

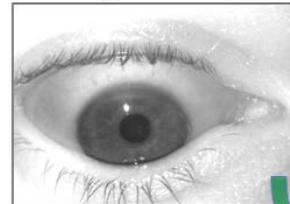
- » Open specifications for iris cameras, iris image properties (quality) and iris image record.
- » Prevent vendor lock-in.
- » Allows for a marketplace of off-the-shelf product.
- » Allows modular integration of products without comprising architecture scope.
- » Allows for performance improvement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

# Prevent GIGO



Subject is not looking into the camera.

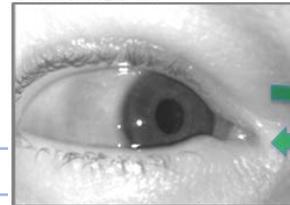
Looking down



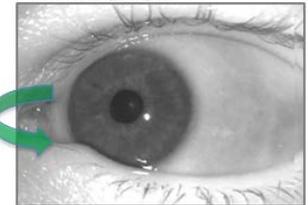
Looking up



Looking left



Looking right



# 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.

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# IQCE :: Quantitative support

- ✕ The 2<sup>nd</sup> activity under 
- ✕ 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

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## 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

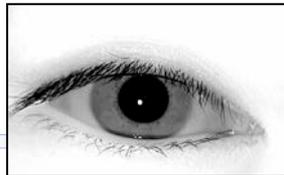
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Information Access Division  
National Institute of Standards and Technology

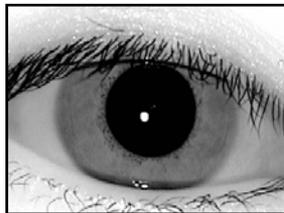


September 30, 2011

# IQCE



raw image



Cropped



VENDOR SUPPLIED IMAGE  
QUALITY ASSESSMENT  
ALGORITHM (IQAA)



**QUALITY  
VECTOR**

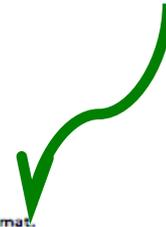
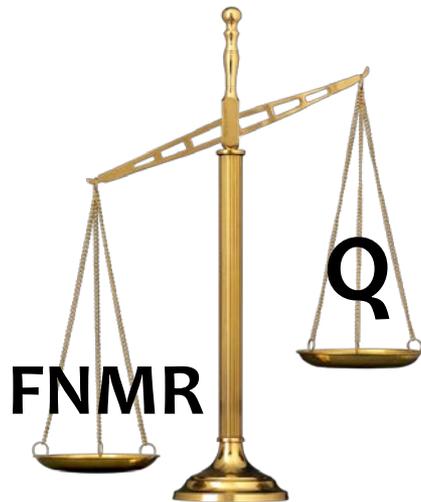
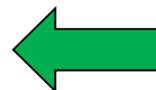


Table 4. IQAAs output format.

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

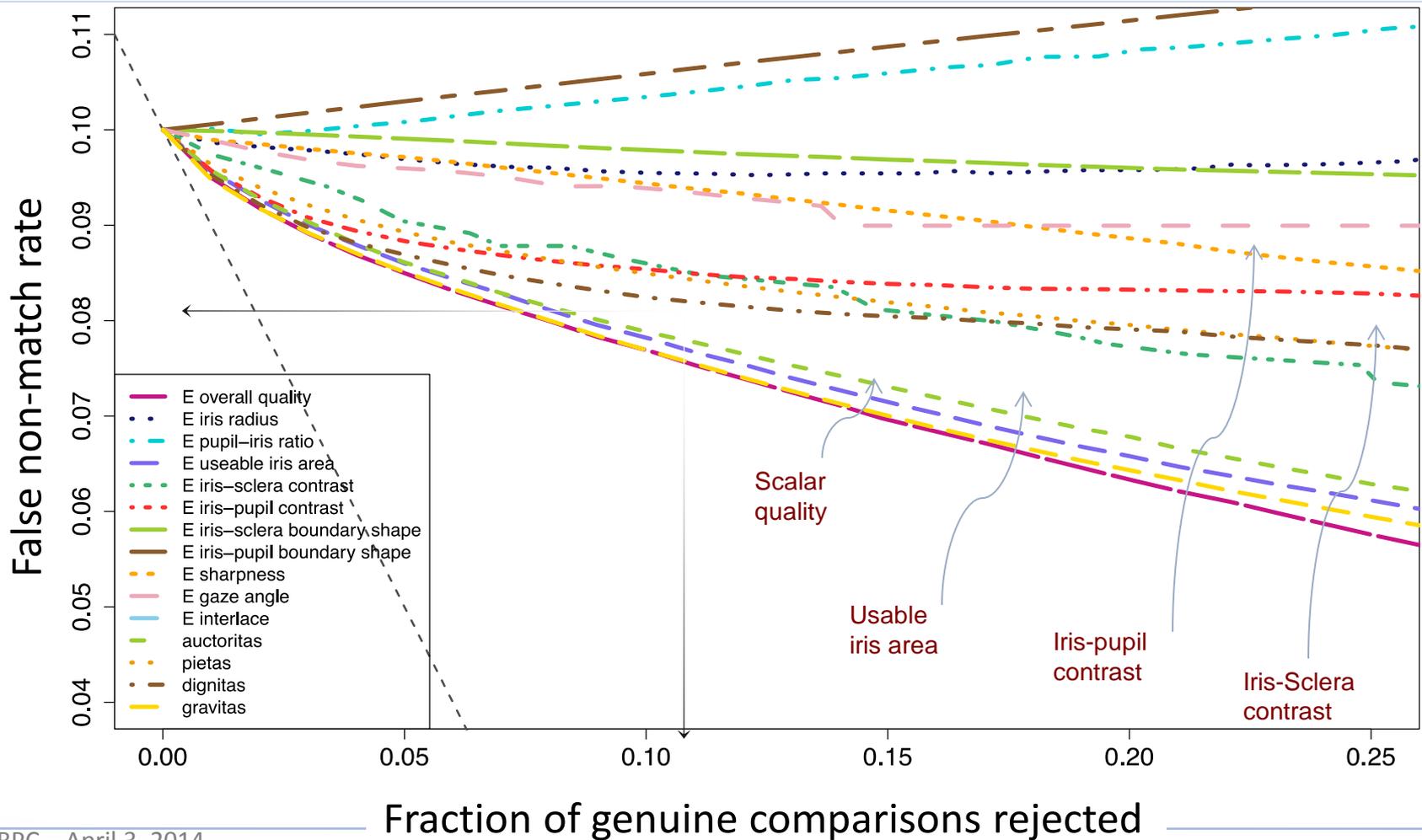
Position	Metric
1	Scalar overall quality
2	Gray level spread
3	Iris radius (in pixel)
4	Pupil iris ratio (ratio of pupil diameter over iris diameter)
5	Iris radius (in pixel)
6	Iris-sclera contrast
7	Iris-pupil contrast
8	Iris-sclera boundary shape (iris shape)
9	Iris pupil boundary shape (pupil shape)
10	Margin (Image scale in N3331)
11	Interlace
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**

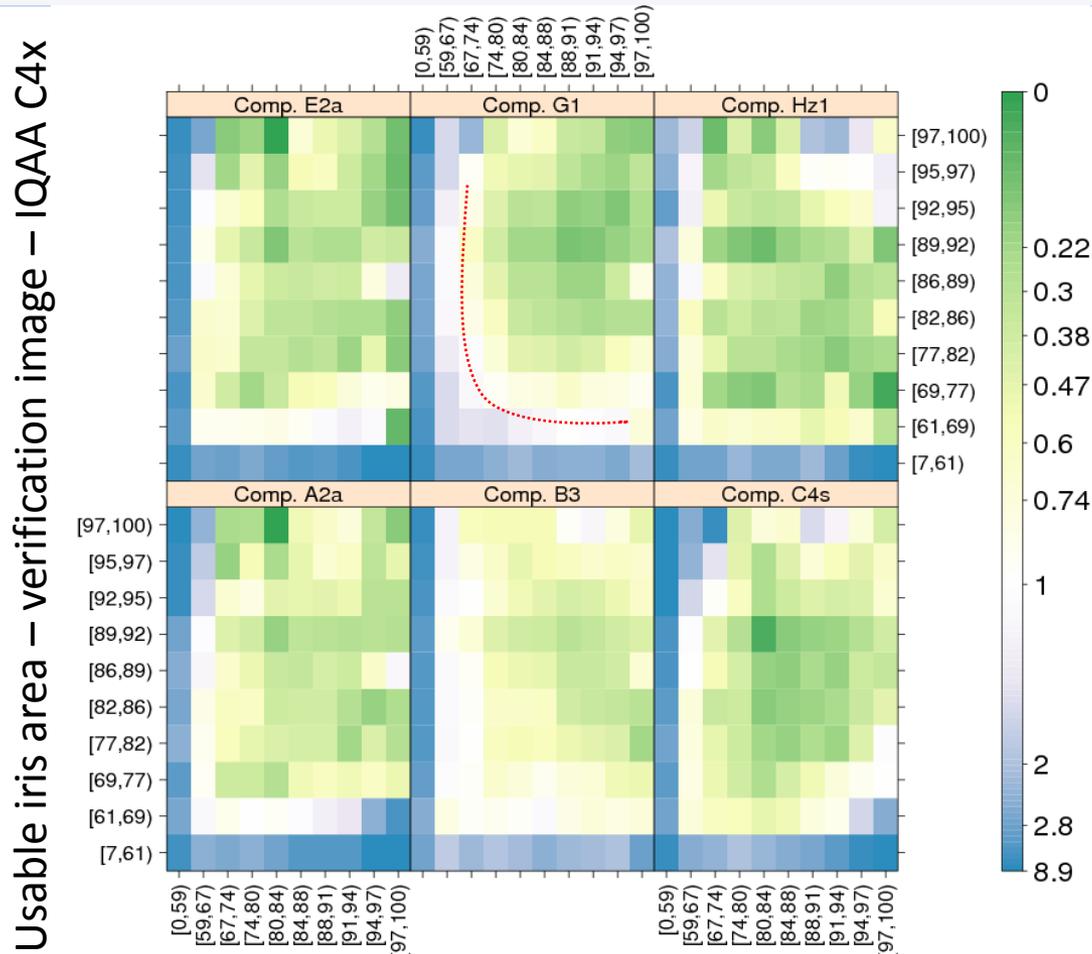


**FNMR**

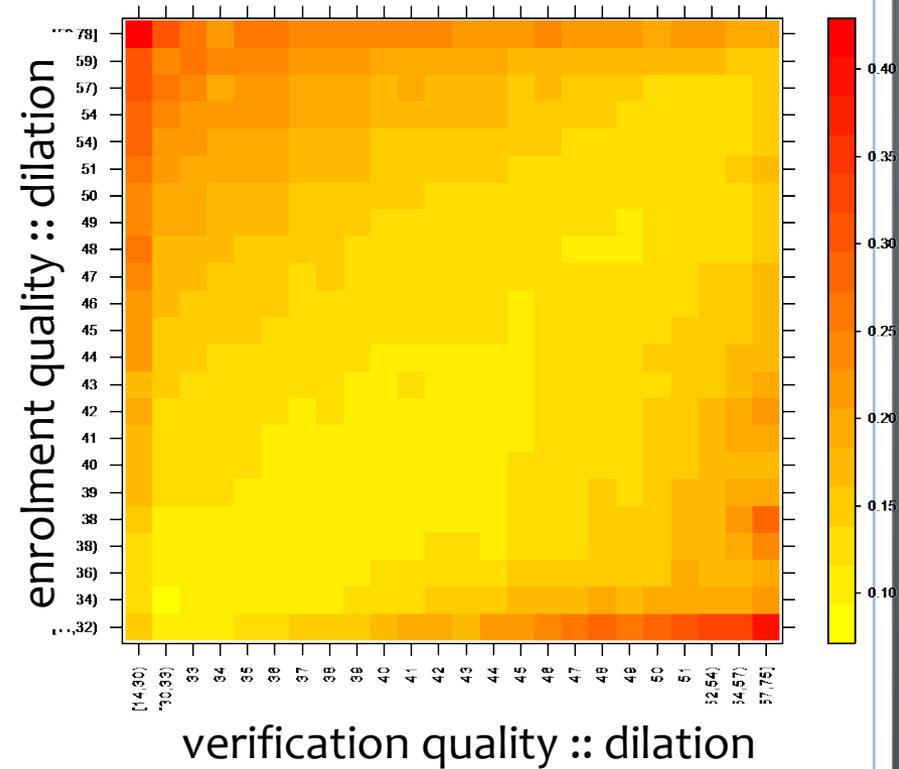
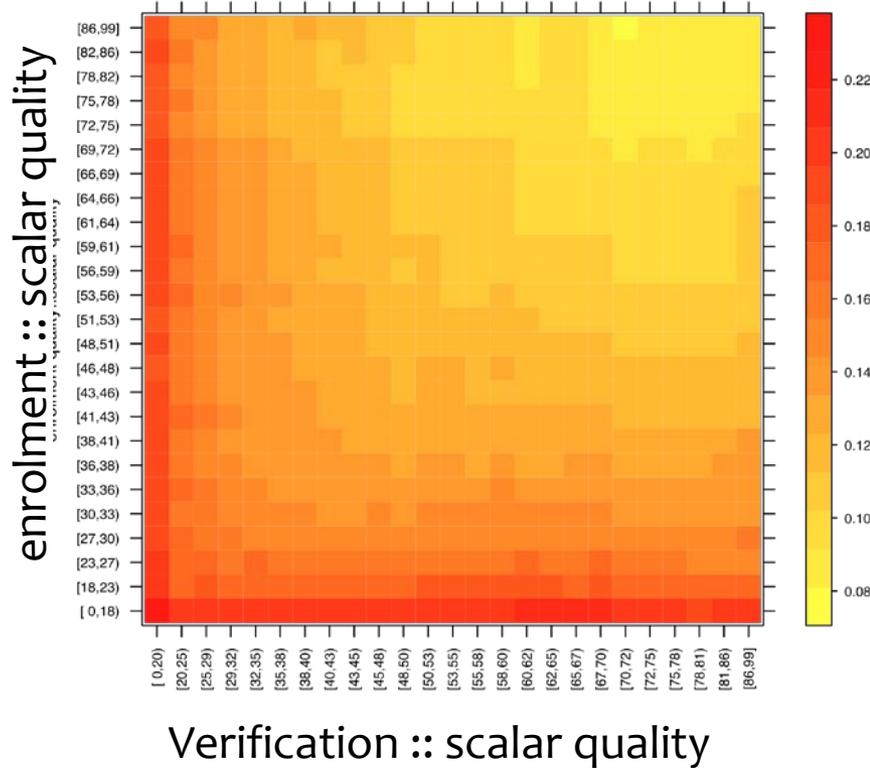
# IQCE:: determining factors affecting iris recognition performance



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



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



# 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

## Editorial Team

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Thank You.

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<http://www.nist.gov/itl/iad/ig/irexii.cfm>

## IREX (Iris Exchange)

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

### IREX I

Accuracy of compact iris images in support of the ISO/IEC 19794-6 and ANSI/NIST Type 17 standards

2008-2009

Test

### IREX II / IQCE

Image quality definition, evaluation, calibration supporting the ISO/IEC 29794-6 standard

2010-2011

Test

### IREX III

One-to-many Iris recognition - Single and two-eye accuracy and resource requirements

2011-2012

Test

### IREX IV

Minimum error (weighted FNIR + FPIR) one-to-many recognition; Rapid ID compression profiles

2012

Test

### IREX V

Instructional and guidance materials for image collection

2012-2013

Best Practice Documents

### IREX VI

Temporal dependence, Iris aging, template aging, longitudinal effects.

2012-2013

Test

### IREX VII

Abstraction layers Encapsulating core iris processing functions

2013-

Best Practice Documents



# Technical Approach

Test performance and interoperability of the standard

e.g. MINEX 04

Identify gaps/outreach (NWIP,AMD)

e.g. Liveness

Development of clear, robust, tested, and implementable content through extensive study and experiments, e.g. IREX I + IQCE

Advocate for NIST/USG position at M1 and SC37

Research/(large scale) evaluation

e.g. IREX

Editorship of 8 intl. std Host workshops

Submit comment + Technical contribution

aimed at strengthening the science behind the claims or preventing overly prescriptive requirements