Usefulness of Existing Iris Databases and Future Priorities

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Iris recognition is extremely accurate when the quality of the images is good.

The IREX III supplemental report found that of 1,013 searches that failed to return the correct mate (for any of the top 3 matching algorithms), in every case there was some problem with one of the images.

Performance of an operational system will be determined by the poorest quality samples and how frequently they occur.
## Available Iris Datasets

### Notre Dame
- ND-IRIS-0405
- Cross Sensor
- Time Lapse
- Template Aging
- Contact Lenses
- Gender Prediction
- Face / Ocular Challenge

### West Virginia University
- Multi-modal
- Off-Axis
- Synthetic Iris

### University of Beira
- UBIIRIS.v1
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### Clarkson University
- Q-FIRE (face + iris)
- Liveness Detection

### UTIRIS
- Visible + Near-IR

### BioSecure
- Desktop Dataset

### MultiMedia University
- MMU1
Pupil Dilation

“[W]hen matching … images of the same person, larger differences in pupil dilation yield higher template dissimilarities.”

- Hollingsworth, Bowyer, Flynn
  *Computer Vision and Image Understanding*, 2009

Dilated

Constricted
Pupil Dilation
Contact Lenses

Two types:
1) Vision correction lenses
2) Patterned contact lenses

Notre Dame has a dataset of iris images of people wearing contact lenses:
http://www3.nd.edu/~cvrl/CVRL/Data_Sets.html
Iris Ageing

Irreversible changes to the healthy iris or neighboring anatomy that yield mated dissimilarity scores that increase monotonically with time-separation of the compared images.

- IREX VI
Iris Ageing*

* Fenker and Bowyer use a different definition of ‘template ageing’.

Figure Source: “Analysis of Template Aging in Iris Biometrics.” Fenker and Bowyer, *IEEE Computer Society Biometrics Workshop*, 2012
Iris Ageing

- IREX VI includes a comprehensive re-analysis of the Notre Dame iris collections.

- It also searched for an ageing effect in two other iris datasets:
  - NEXUS (Canadian border crossing)
  - OPS (Operational data from DoD)

- Conclusion: “[W]e find no evidence of a widespread iris ageing effect”

- The re-analysis of the Notre Dame data concluded that when you normalize for pupil dilation and eyelid occlusion, the apparent ageing effect goes away.

![Graph showing the decision threshold with and without normalization.](image)
Irregular Pupils

The IREX III Failure Analysis Report determined that 45 of 1,013 failed searches probably failed due to abnormal pupil shapes.

Possible Medical Explanations:

Coloboma

Tadpole Pupil

Image Sources: medicalpicturesinfo.com, pbs.org
Illumination

Differences in illumination can make non-flat surfaces appear different.

source: landsat.gsfc.nasa.gov
Illumination

- Most cameras illuminate from the front to restrict specular highlights within the pupil.

- Differences in illumination can still occur due to ambient lighting.

- Ambient lighting can also introduce Purkinje Images.
NOTE: CASIA-Iris-Lamp 4.0 contains images where a lamp was turned on near the subject to ‘introduce more intra-class variations’, but the images do not contain noticeable Purkinji Images.
Eye Colour

- Does the colour of the eye affect recognition accuracy?
- Lighter coloured eyes seem to have more pronounced features (at least according to my own personal observation!)

Green Eye

Brown Eye
Eye Colour

D02P, blue/green/grey  G01P, blue/green/grey  I02P, blue/green/grey
D02P, brown          G01P, brown          I02P, brown

FNIR

0.01  0.02  0.05  0.1
0.0001 0.0002 0.0005 0.001 0.002 0.005 0.01 0.02 0.05 0.1 0.2

D02P, blue/green/grey  G01P, blue/green/grey  I02P, blue/green/grey
D02P, brown          G01P, brown          I02P, brown

Light eyes

Dark eyes

(Fenolicted Population Size = 1,600,000)
Iris as a Forensic

Forensic Science
“*The application of scientific knowledge and methodology to legal problems and criminal investigations.*”

- legal-dictionary.thefreedictionary.com

Source: National Geographic

Source: 2001: A Space Odyssey (film)

Webcam Image
Future Areas of Research

- Surgical alterations
- Neo-natal
- Ageing
- Iris at a distance
- Abnormal Pupils
- Purkinji Images

Also, larger sets of iris images wouldn’t hurt (i.e. with more subjects represented).
Datasets Referenced

University of Tehran (UTIRIS) – Visible and Near-IR iris captures.
https://utiris.wordpress.com/

Notre Dame (ND) – Iris Ageing, Contact Lenses (and more)
http://www3.nd.edu/~cvrl/CVRL/Data_Sets.html

CASIA-Iris-Lamp – Images with a side lamp turned on/off
http://biometrics.idealtest.org/
Thanks

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http://iris.nist.gov/