Optimizations in Iris Recognition

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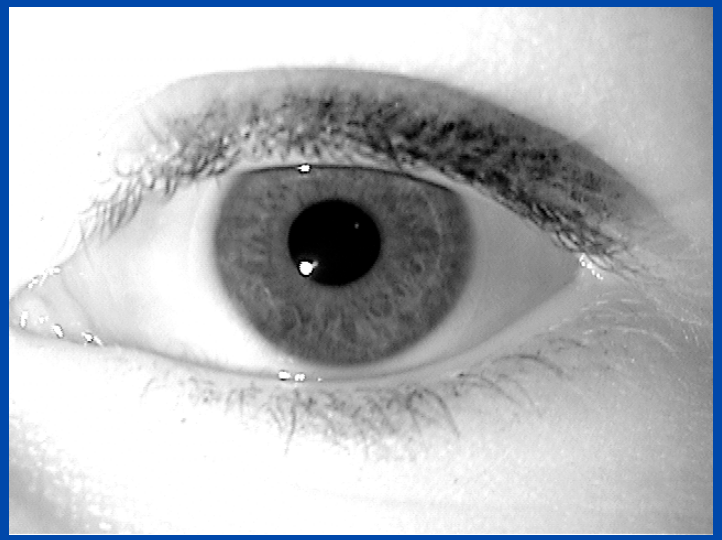
Outline

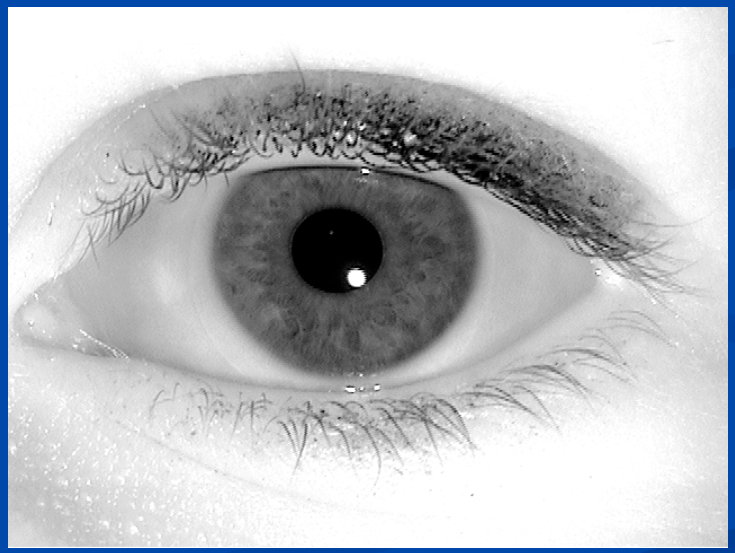
- Introduction
- Experiments on Iris Recognition
  - Data acquisition
  - Implementation & Optimization
  - Results
- Final Remarks
- Citation
- Conclusion

Data Acquisition

- LG EOU2200 system
- 640x480 Intensity Images

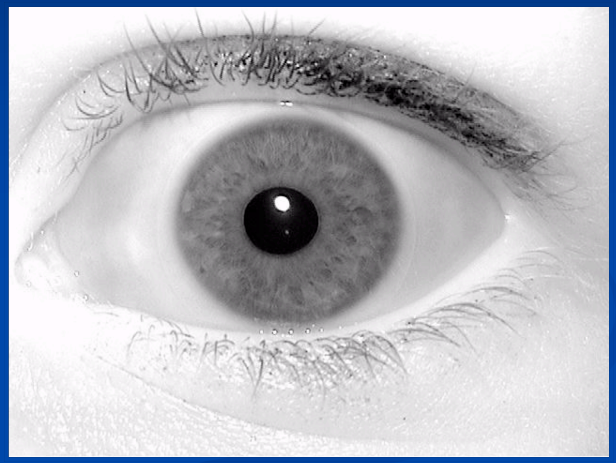
Quality Metrics:
Iris (226, 298, 114)
Pupil(228, 288, 41)
Percent Iris=98;
Focus=98;
Motion Blur=0

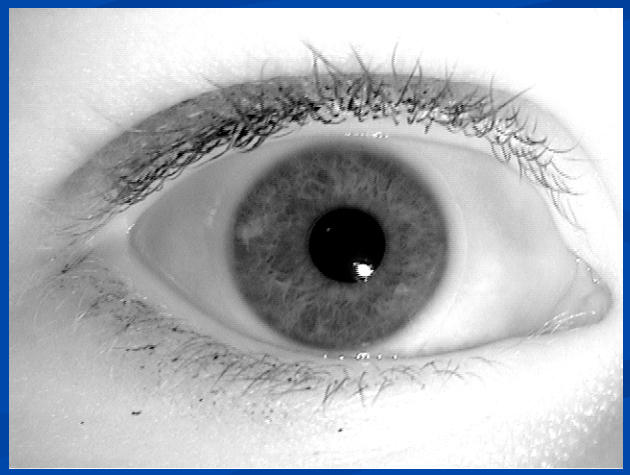




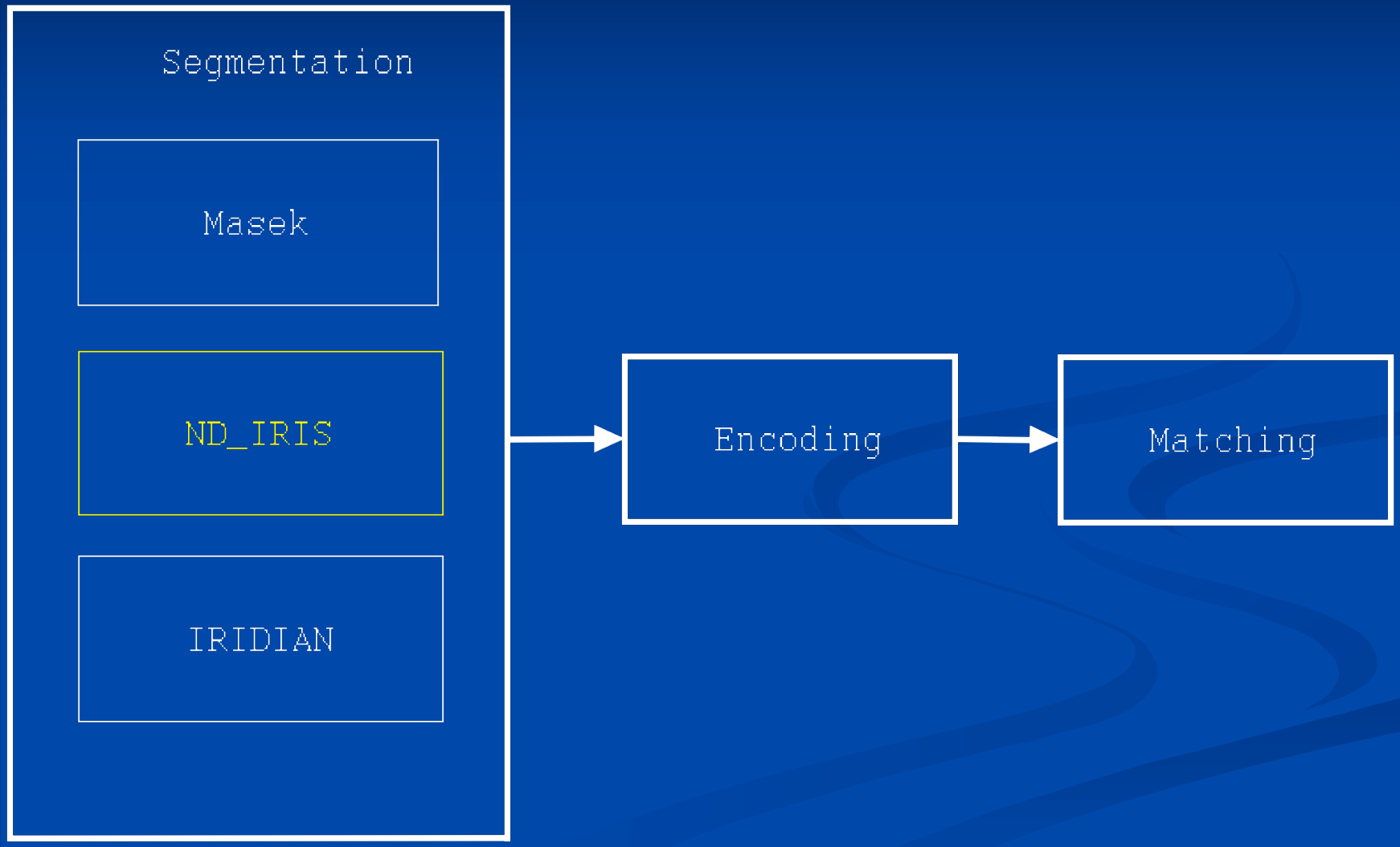
Data Sets

- ICE: Iris Challenge Evaluation (http://iris.nist.gov/ice/)
- Gallery Set
  - Left iris images: 317
  - Right iris images: 327
- Probe Set: a superset of the ICE 1.0 data



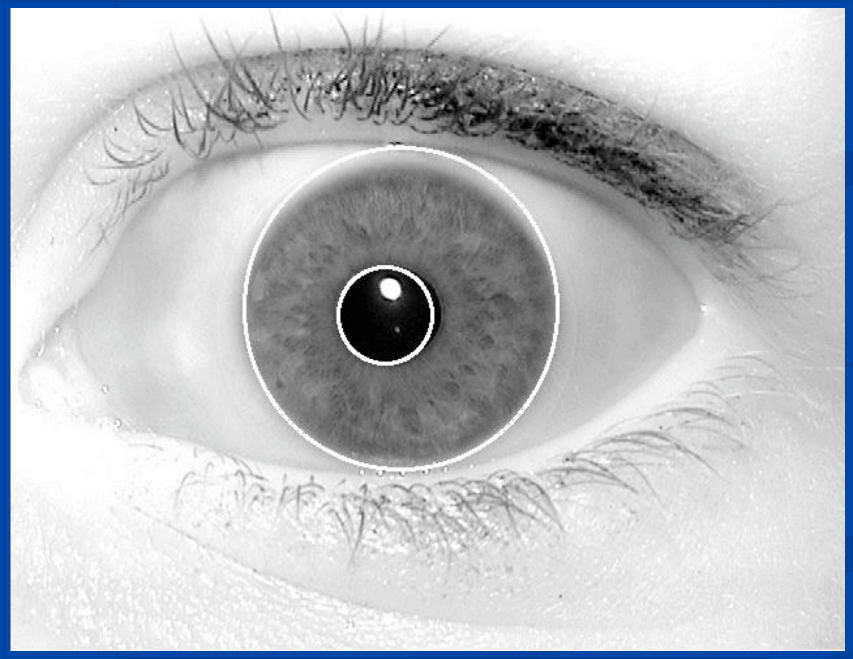


Iris Recognition



Masek's Segmentation

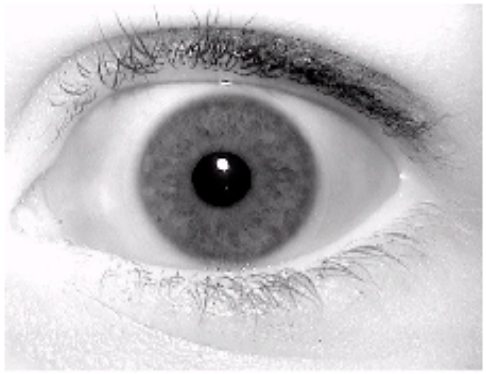
- Canny Edge Detector
- Hough Transform



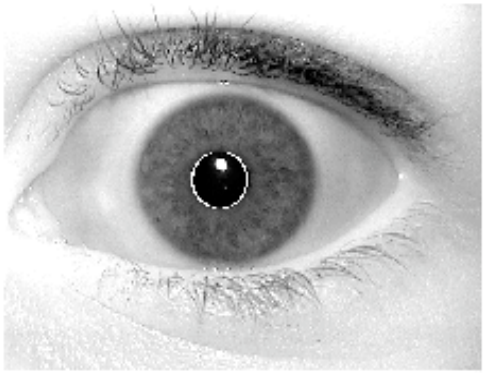
Optimizations in Iris Segmentation

- Reverse Detection Order
- Reduce Edge Points
- Modification on Hough Transform
- Hypothesize and Verification

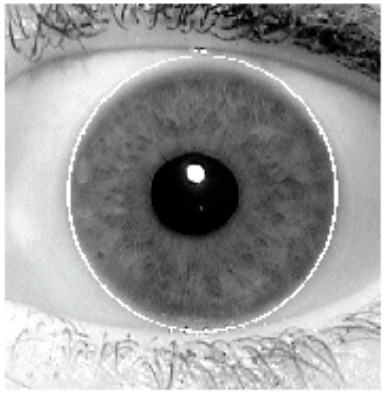
Reverse Detection Order



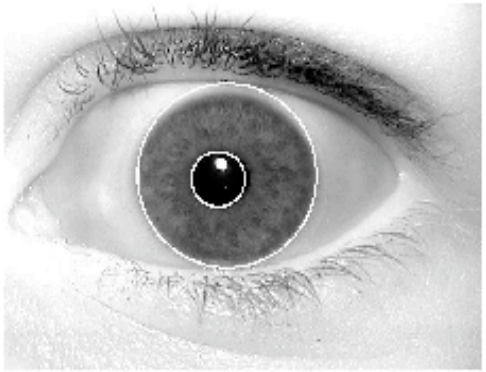
(a) Original iris image.



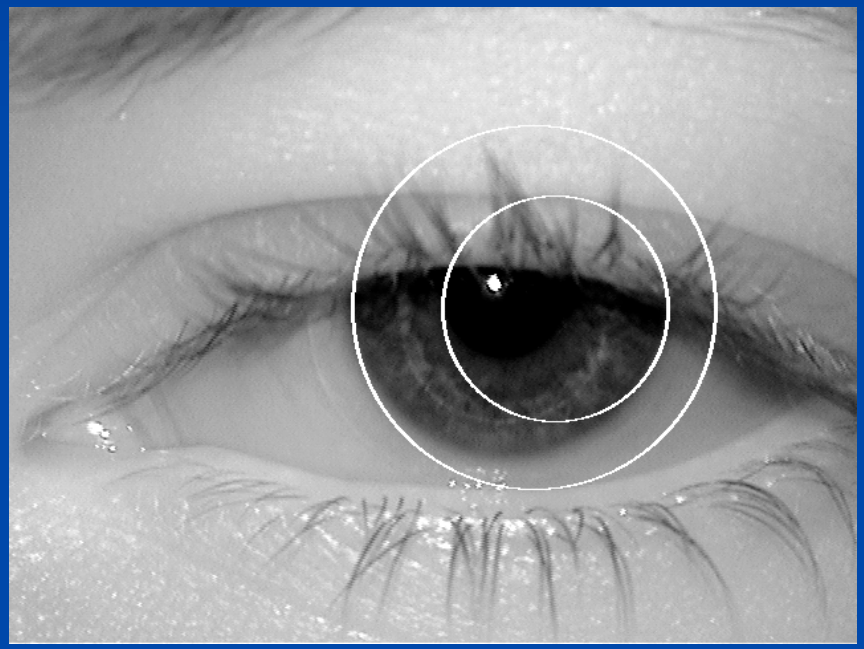
(b) Step 1: detect the inner boundary as the pupil.



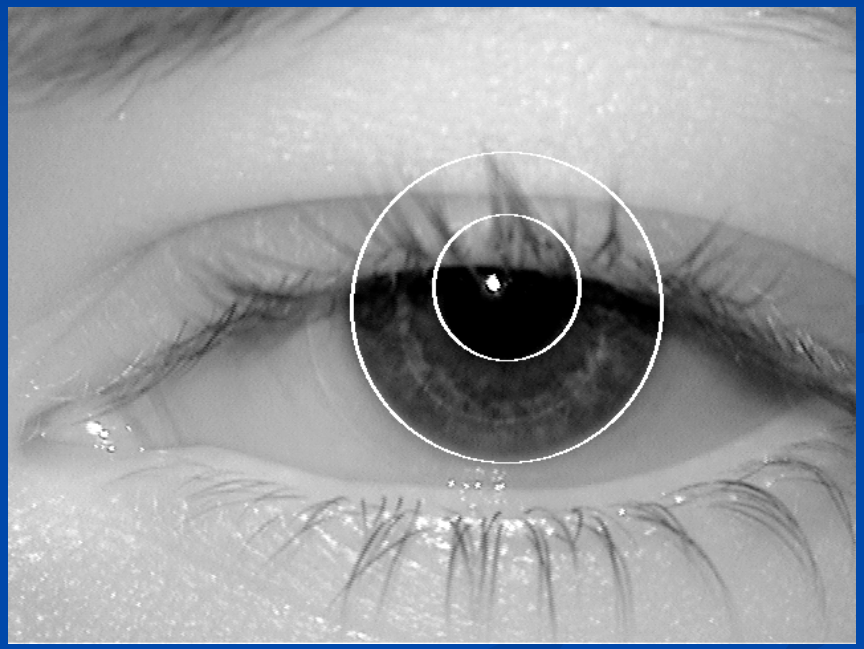
(c) Step 2: detect the outer boundary as the iris.



(d) Final result.

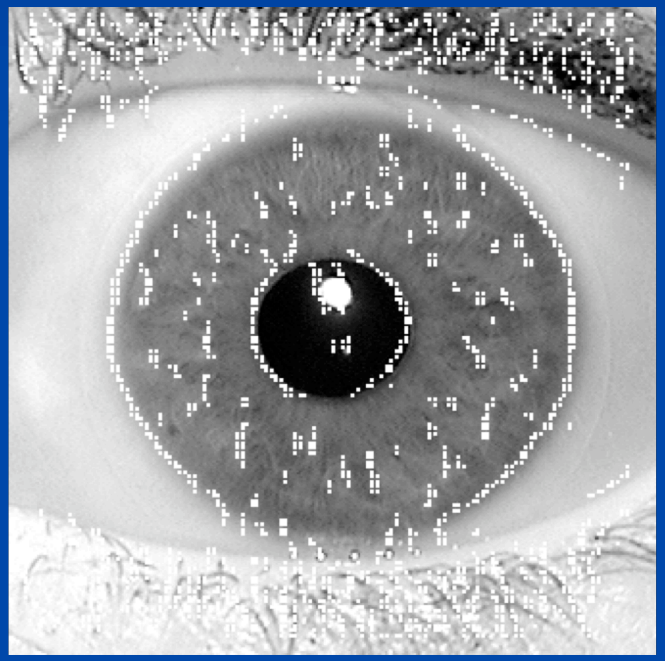


(a) Masek

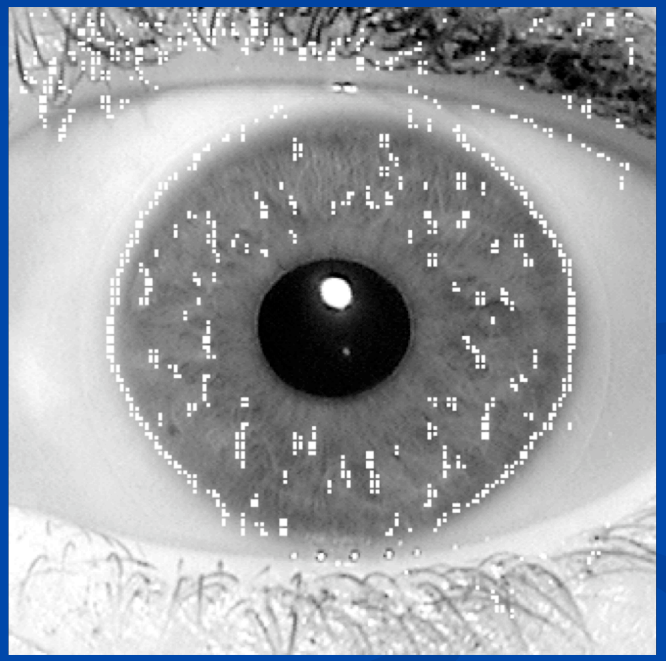


(b) ND_IRIS

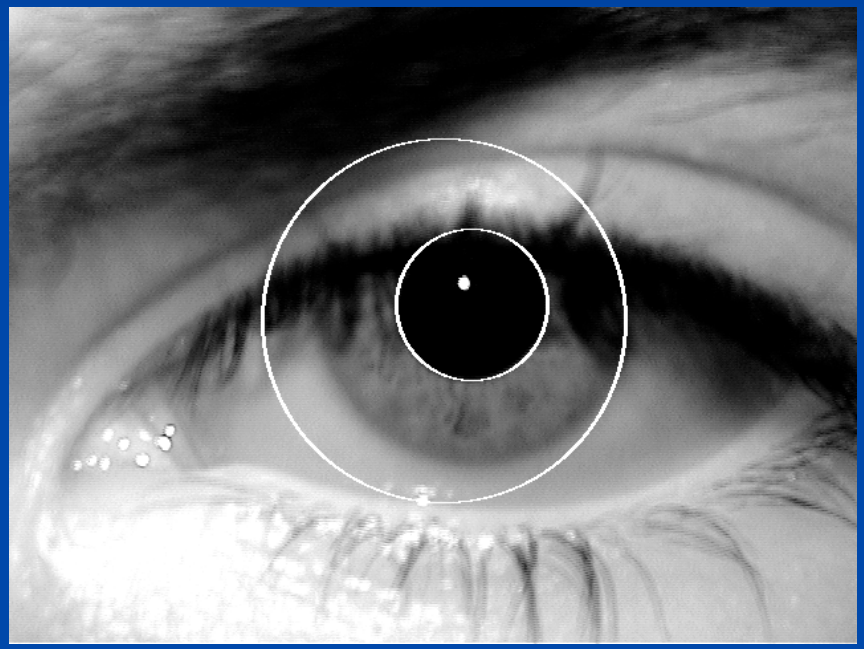
Reduce Edge Points



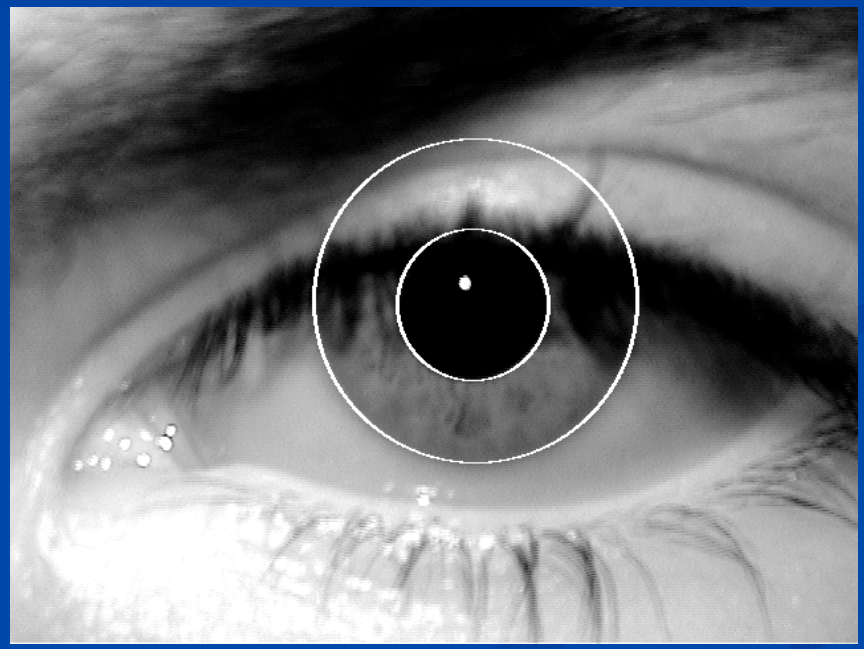
(a) Before reducing



(b) After reducing edge points

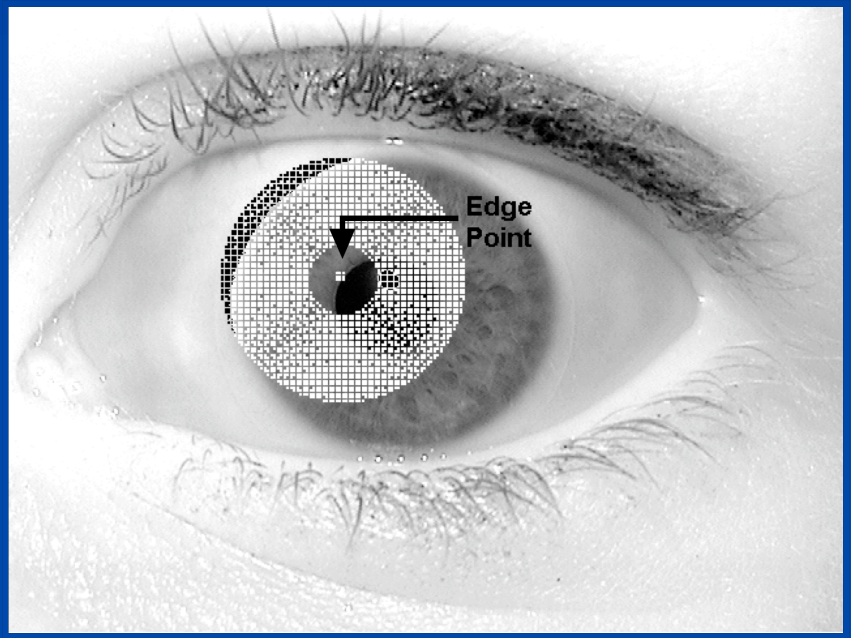


(a) Masek

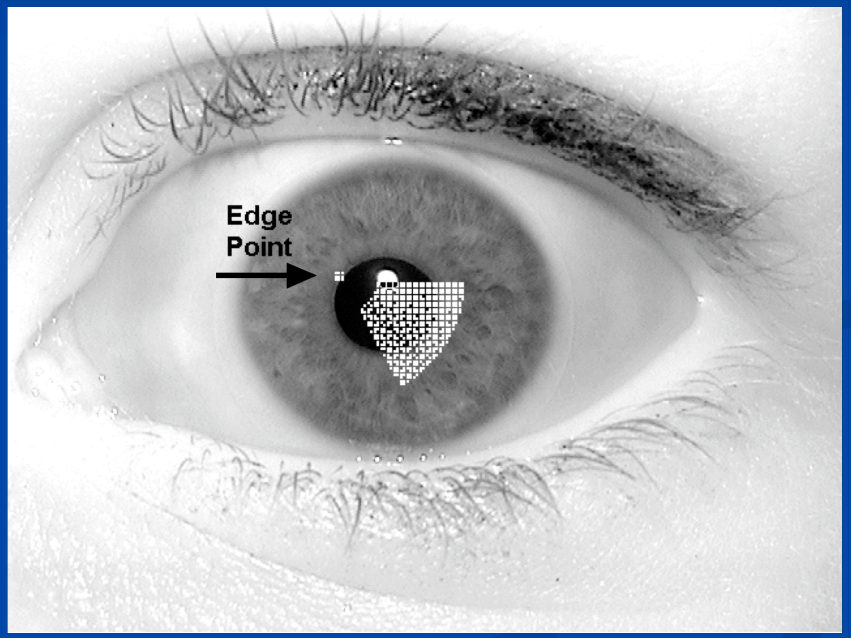


(b) ND_IRIS

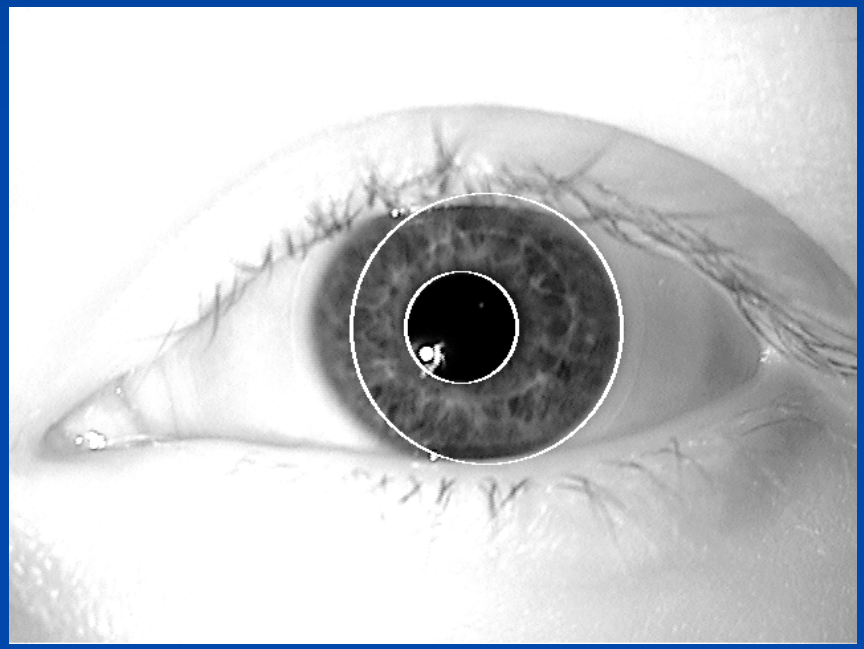
Modification to Hough Transform



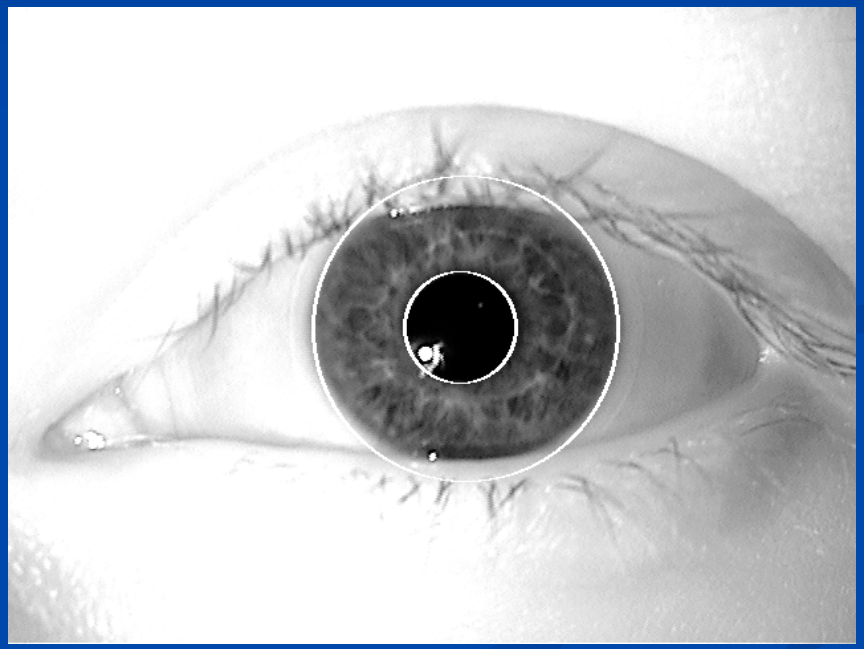
(a) Masek's Algorithm



(b) ND_IRIS

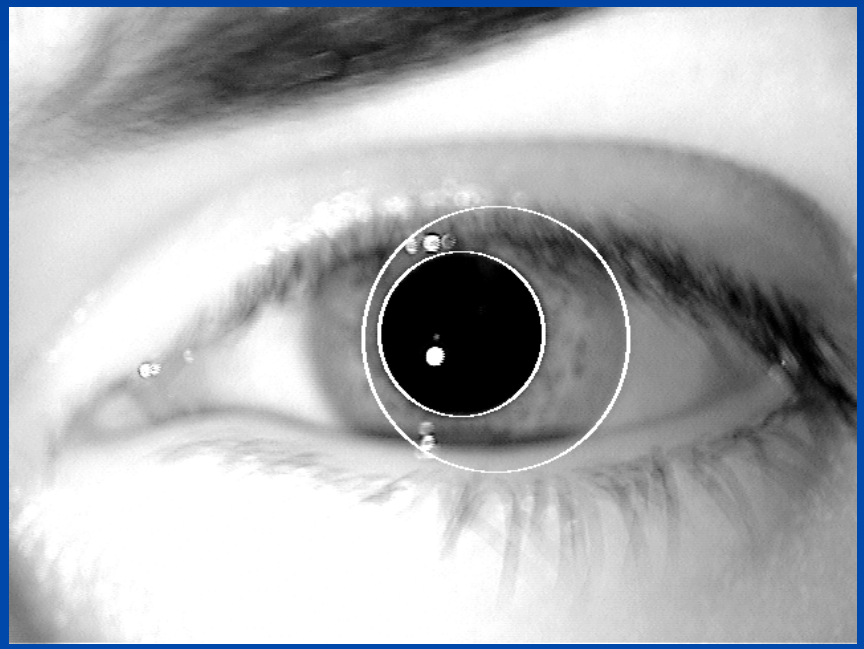


(a) Masek

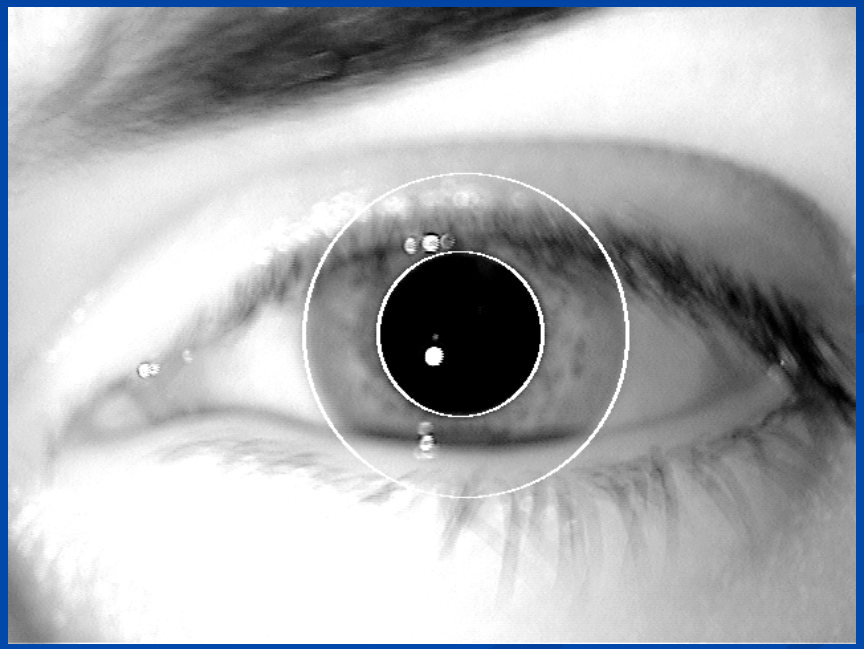


(b) ND_IRIS

Hypothesize and Verify

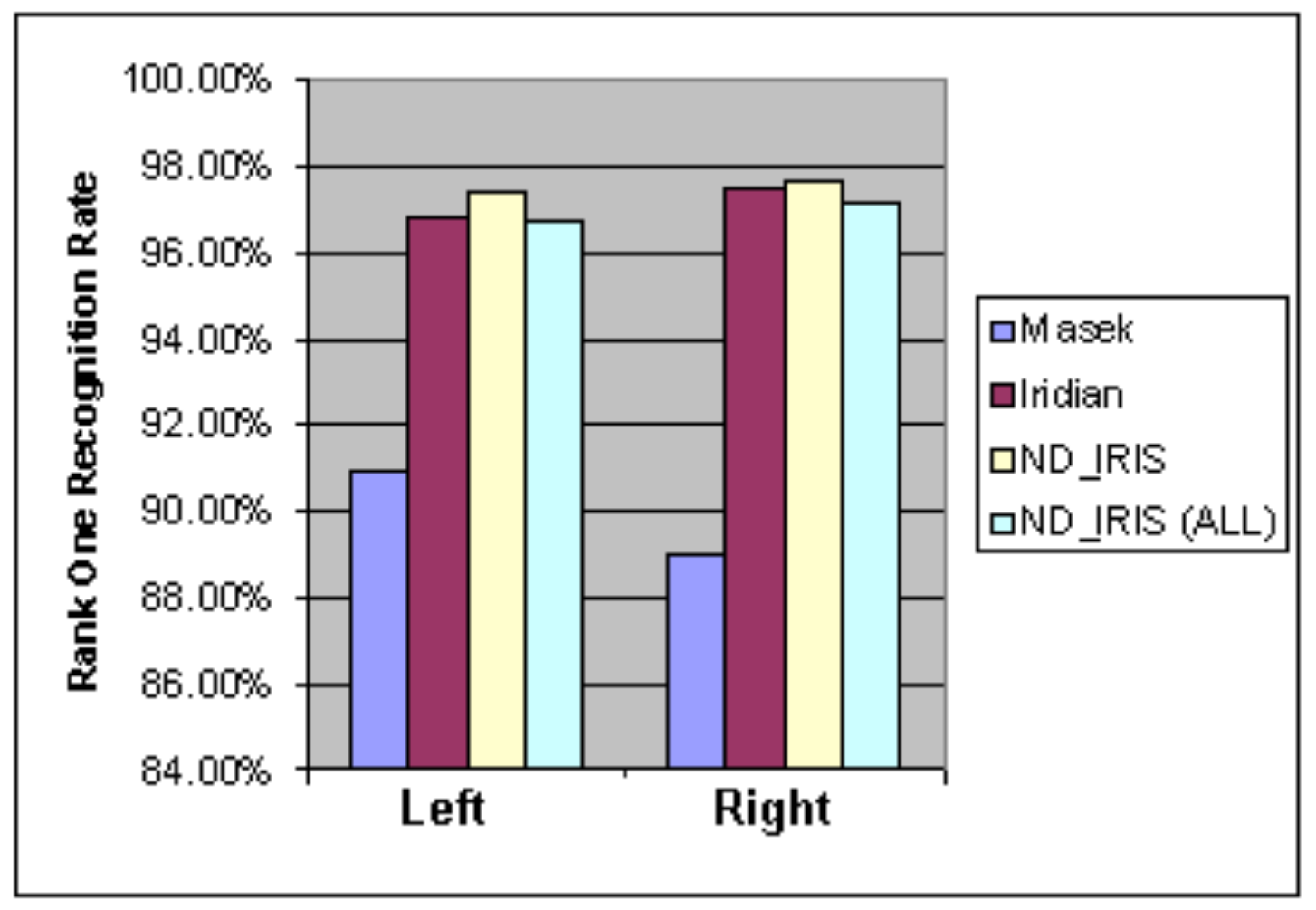


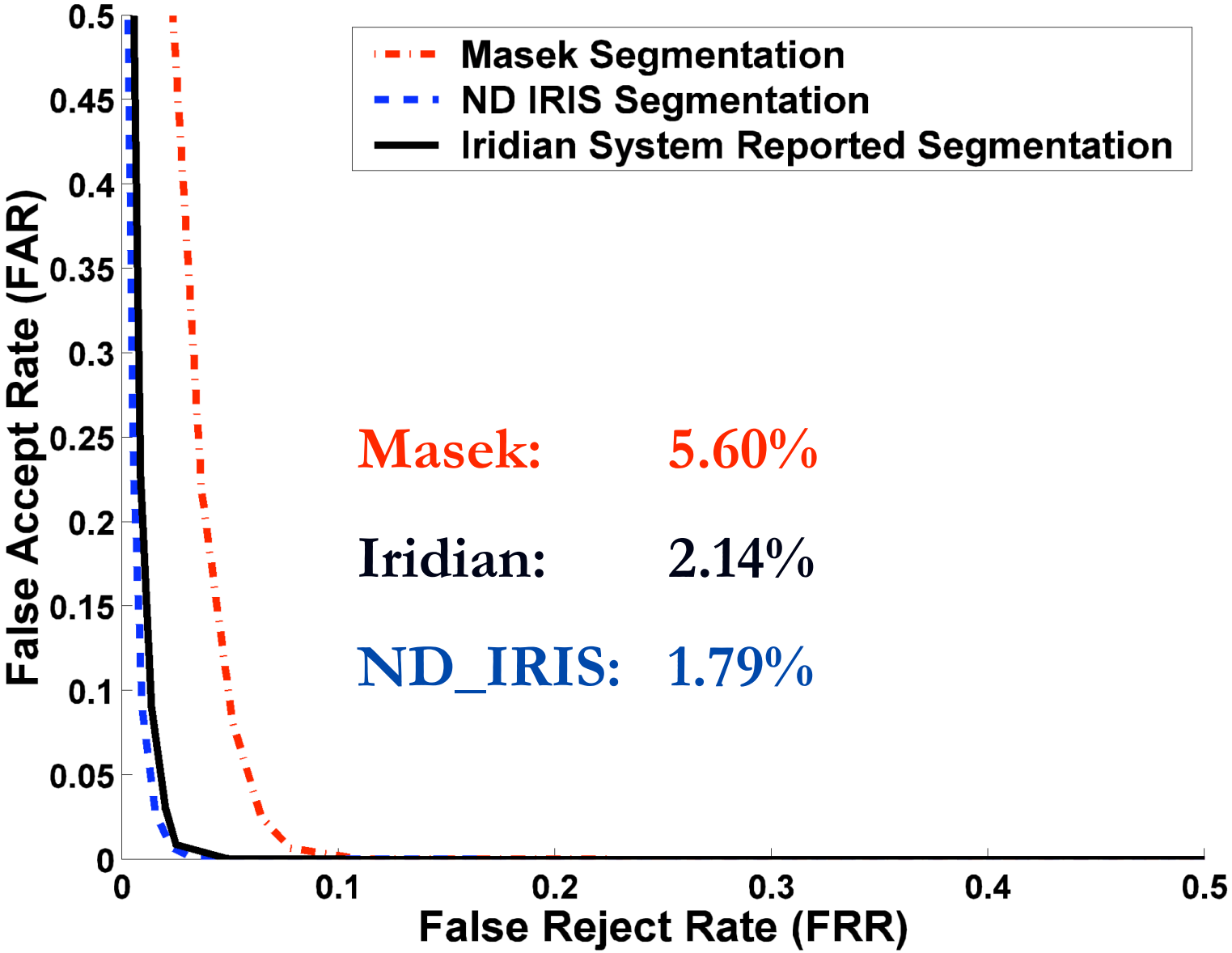
(a) Masek



(b) ND_IRIS

Experimental Results



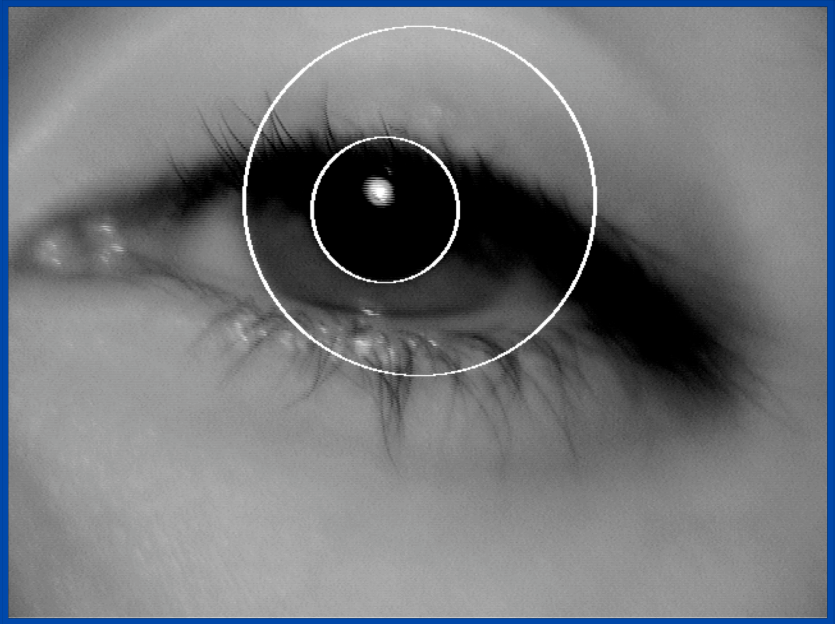


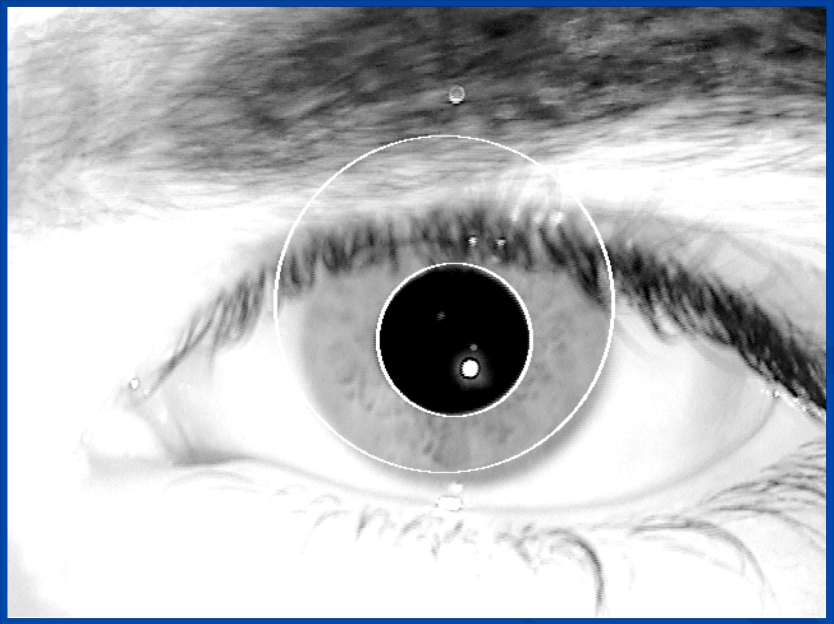
Masek: 5.60%

Iridian: 2.14%

ND_IRIS: 1.79%

Incorrect Segmentations

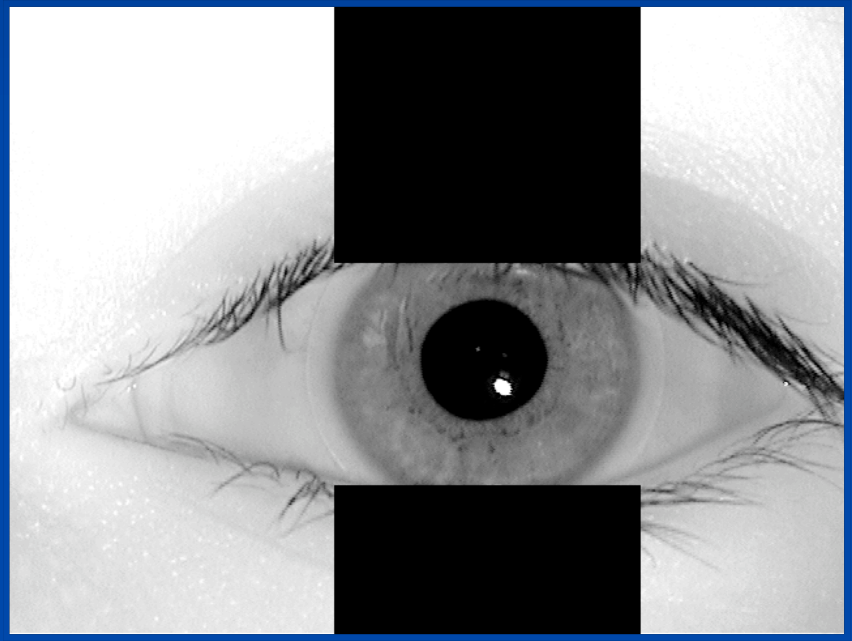




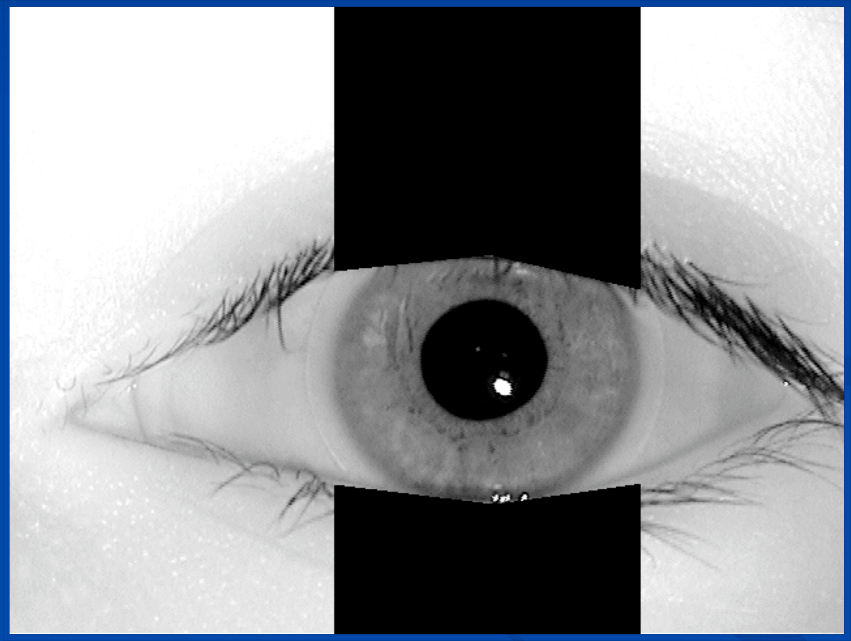
Observation

- Eyelids and eyelashes (chiefly the upper lid for our data) appear to be the big remaining complications.
- Is a more sophisticated segmentation technique worth more than more sophisticated [illegible] metric?

Optimizations in Eyelid Detection



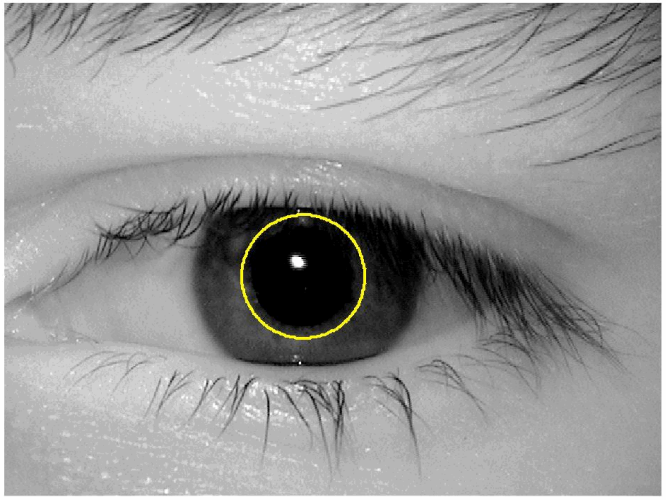
(a) Masek



(b) ND_IRIS

Snake Model

- Snakes:
  - Active contour model
  - An energy minimizing spline pulled toward edges
  - Demo
  - Desdigned to deal primarily with occlusions, not with acircularity of the pupillary and limbic boundaries

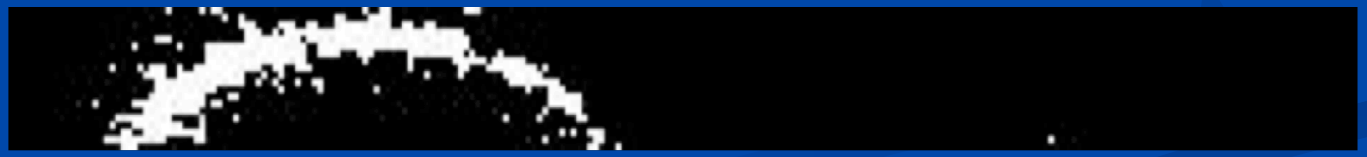


Unwrapped Iris Images

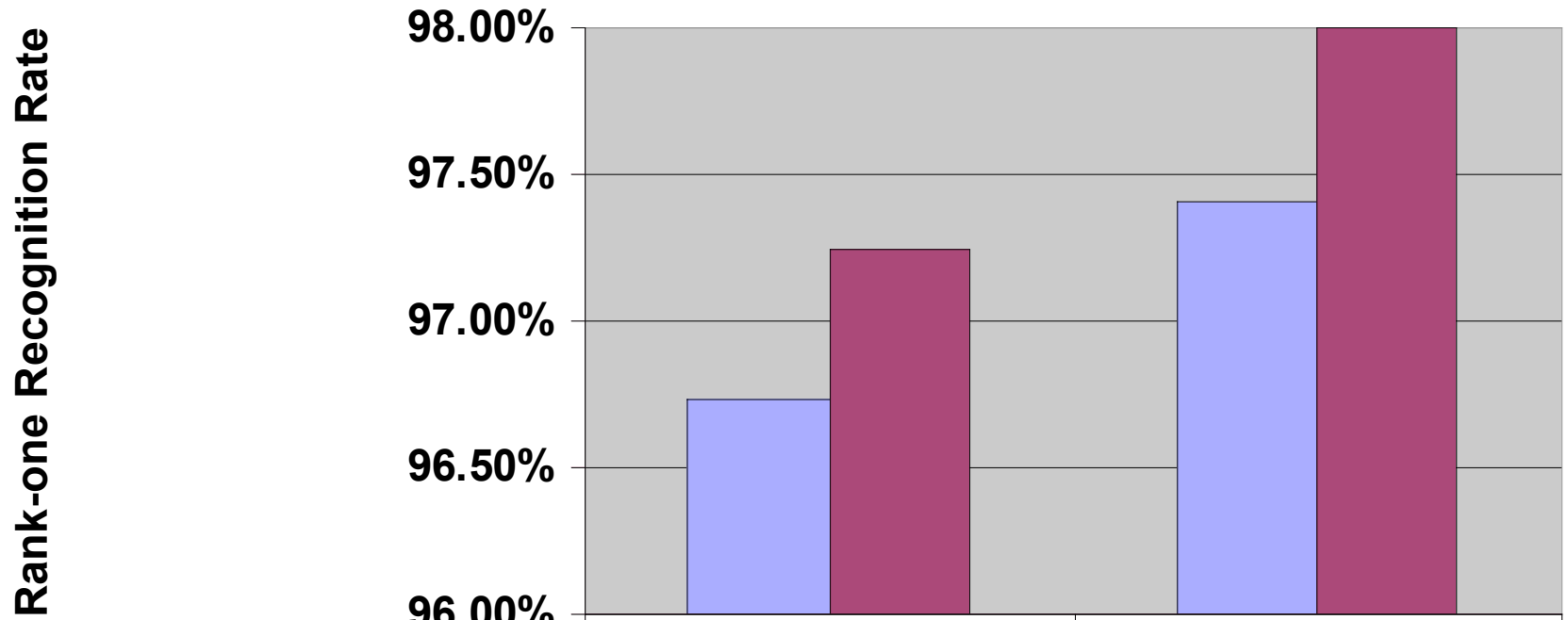
Initially Marked Noise Areas

Results from the Snakes Model

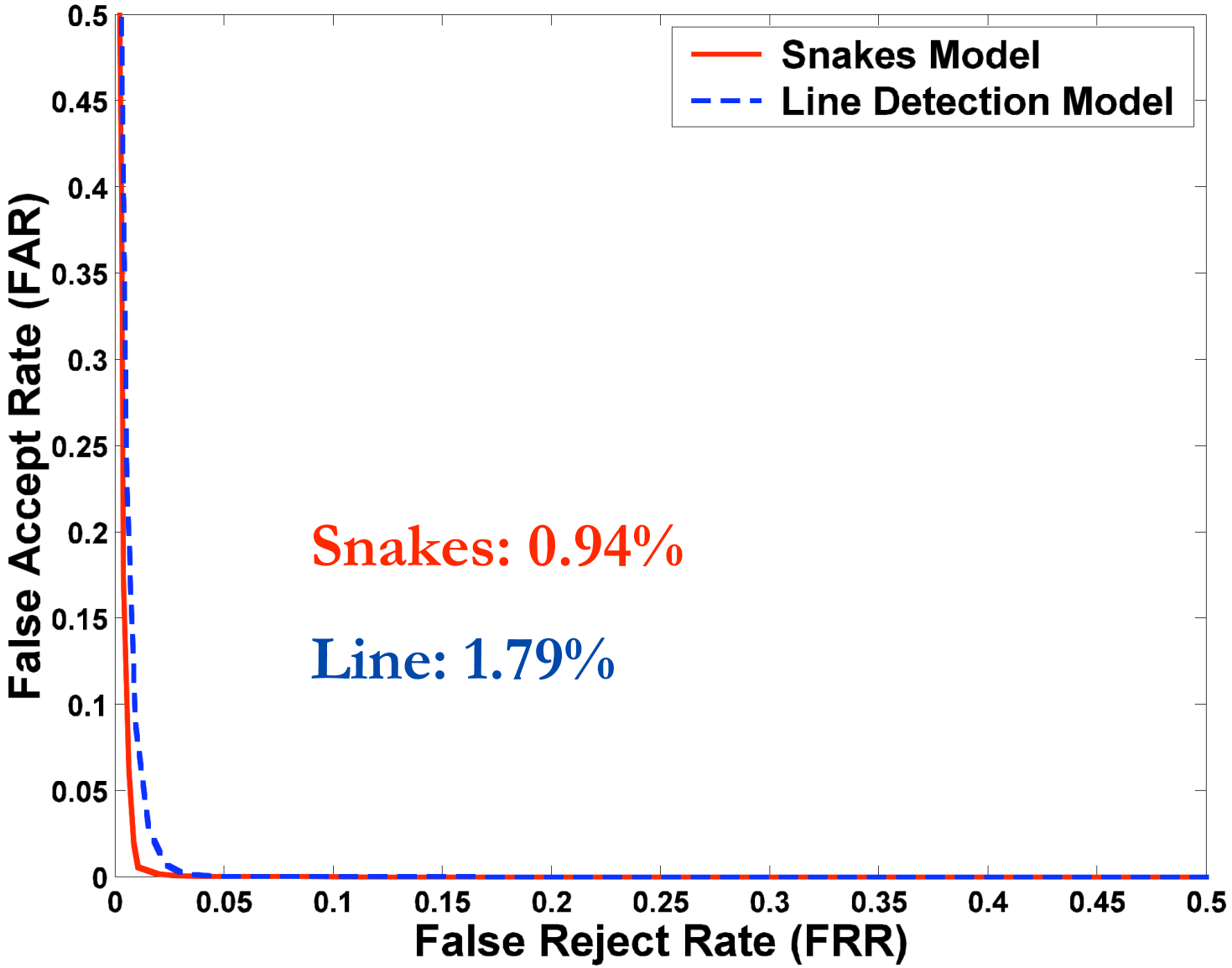
Results from Line Detection Model



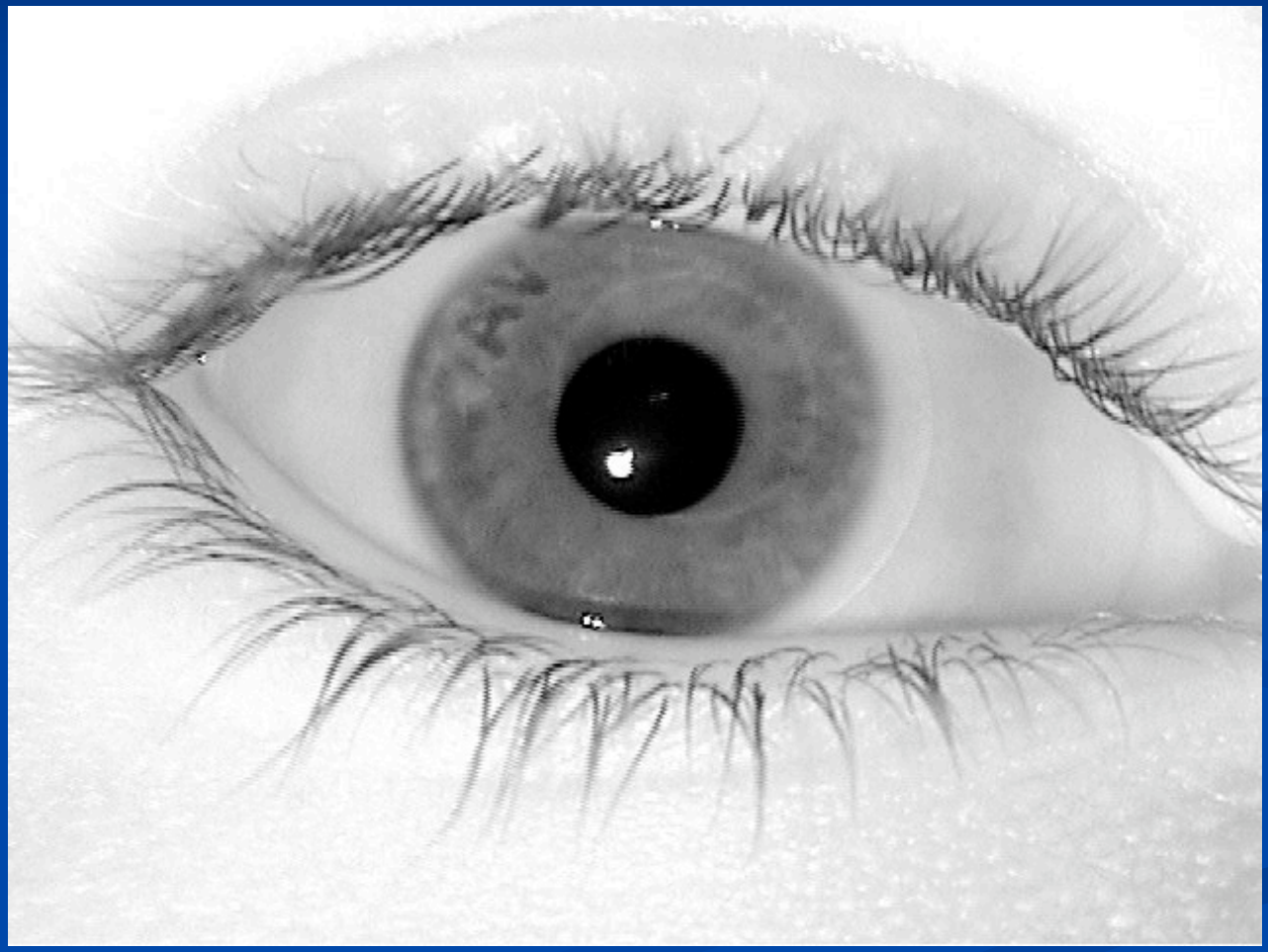
Noise Detection Methods Compared



	Left (all)	Left (metrics)
Line Detection Method	96.73%	97.41%
Snakes Model	97.24%	98%


Snakes Model
Line Detection Model
False Accept Rate (FAR)
False Reject Rate (FRR)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Snakes: 0.94%
Line: 1.79%

Lens markings



Citation

X. Liu, K.W. Bowyer, P.J. Flynn, Iris Recognition and Verification Experiments with Improved Segmentation Method, *Proc. Fourth IEEE Workshop on Automatic Identification Advanced Techniques (AutoID 2005)*, October 2005, Buffalo NY, pp. 118-123.

Conclusion

- Re-implemented Masek's Iris Recognition System
- Optimized Iris Segmentation Stage
  - 6% higher rank one recognition rate than the Masek segmentation
  - A little bit higher than using the Iridian reported segmentation
- Optimized Noise Detection Stage
- Optimized Matching Stage
- Combined the Optimizations Together