IREX III
Performance of 1:N Iris Recognition Algorithms

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IREX III

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Imagery

BIMA
Biometrics Identity Management Agency

IREX Team

- Patrick Grother
- George Quinn
- James Matey
- Elham Tabassi (IREX II lead)

IREX Timeline

- API + CONOPS published Nov 2010
- Algorithm submission from February 2011 → August 2011
- Final report October 2011.

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IREX III :: By The Numbers

When, Where, Who

- Two algorithm submission phases
  - 1. February – June, 2011
  - 2. August 2011
- NIST
  - Sequestered data
  - Up to 55 blades; Up to 880 cores, each 192GB memory
- 11 organizations
  - 2 academia, 9 commercial, 0 from NIST
- Up to 10 algorithms per organization
  - 92 tested

How, how big

- Parent Corpus
  - 2212342 people
  - 4333745 eyes
  - 6142289 images
- Enrolment populations
  - 20K, 160K, 1.6M, 3.9M single eye
  - 20K, 160K, 1.6M, two eyes
- Searches
  - 239K mate
  - 314K nonmate
- Comparisons
  - 239K mate searches
  - 1228 billion nonmate comparisons
    - Using N = 3.9M enrollment

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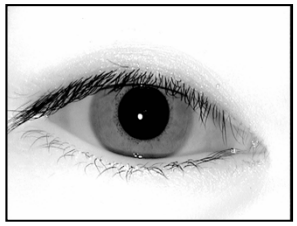
1:N Search

Iris Image



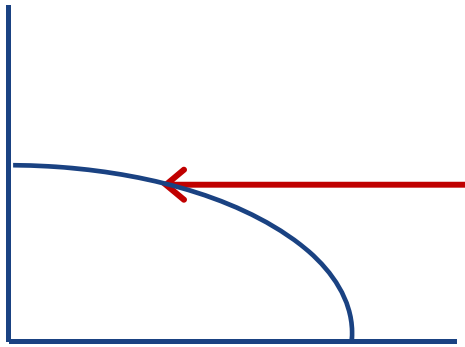
Search Template

Template

N template Enrollment Database

Template

FNIR, aka “Miss Rate”



FPIR

Aka False Alarm Rate

Candidate List

Alice	0.02
Bob	0.34
Christophe	0.38
David	0.39
Ernie	0.45

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Open Set 1:N Search

Operator Adjudication of Search Results

Lights out Identification

As retrieved Saturday September 24, 2011, Jim Henson's 75th birthday

IREX III :: Measurements

Accuracy

- Accuracy
  - FNIR -- Miss Rate
  - FPIR -- False Alarm Rate
- Template generation failure
- Two eyes much better than one?
- Image quality values related to failure?
- Interoperability :
  - Enroll camera A, identify camera B
- Is iris ageing evident / important?
- Effect of geometry
  - Does dilation make a difference?
  - Iris diameter?
- Cumulative match
  - Workload on (forensic) examiner
- 1:N Face vs. 1:N Iris

Resources

- Template size
  - Enrolment template
  - Search template
- Time needed for
  - Template generation
  - Search as function of N.
- Threaded operation vs. naïve parallelism
- Memory usage
  - Static vs. N
  - Dynamic vs. N

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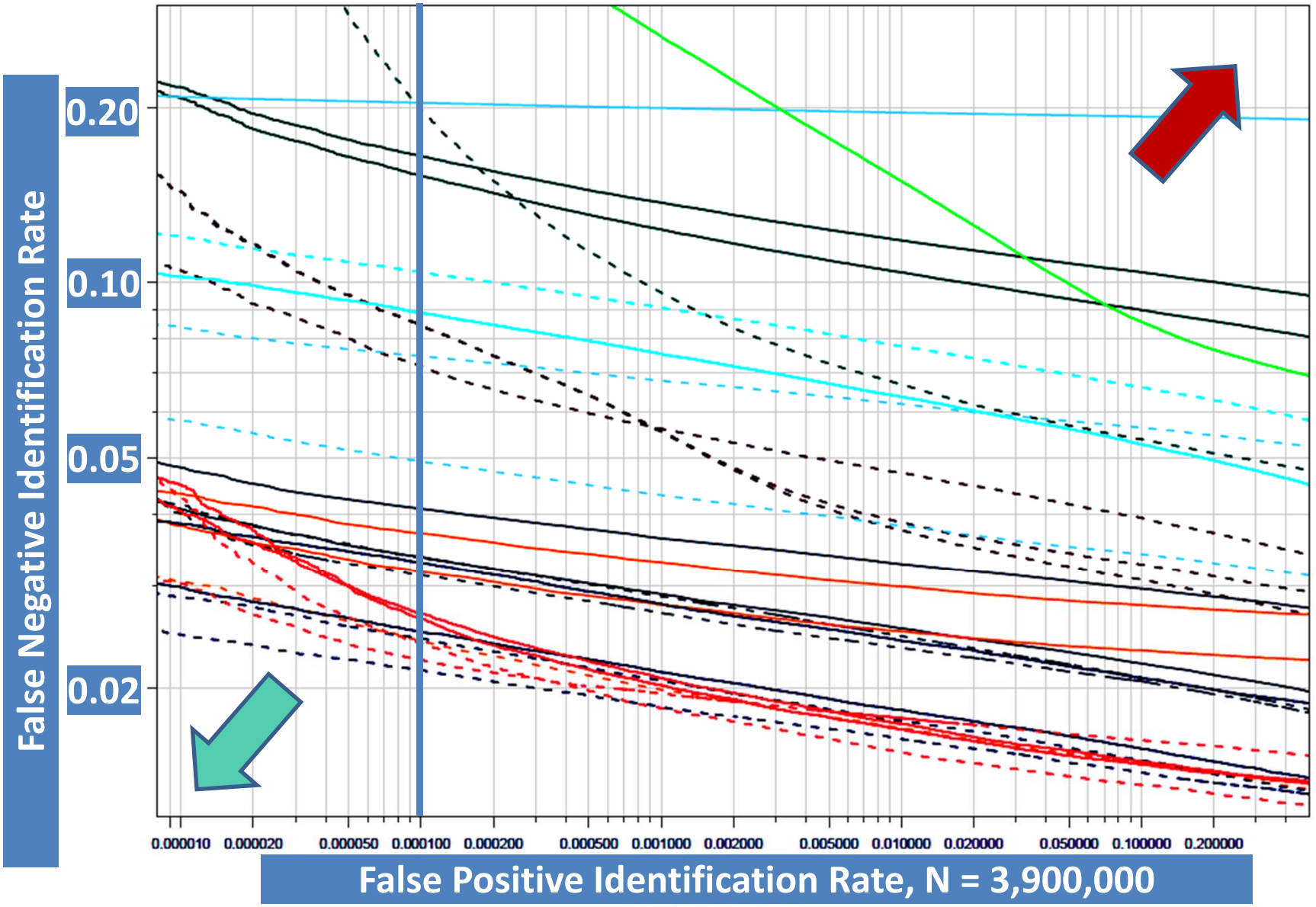
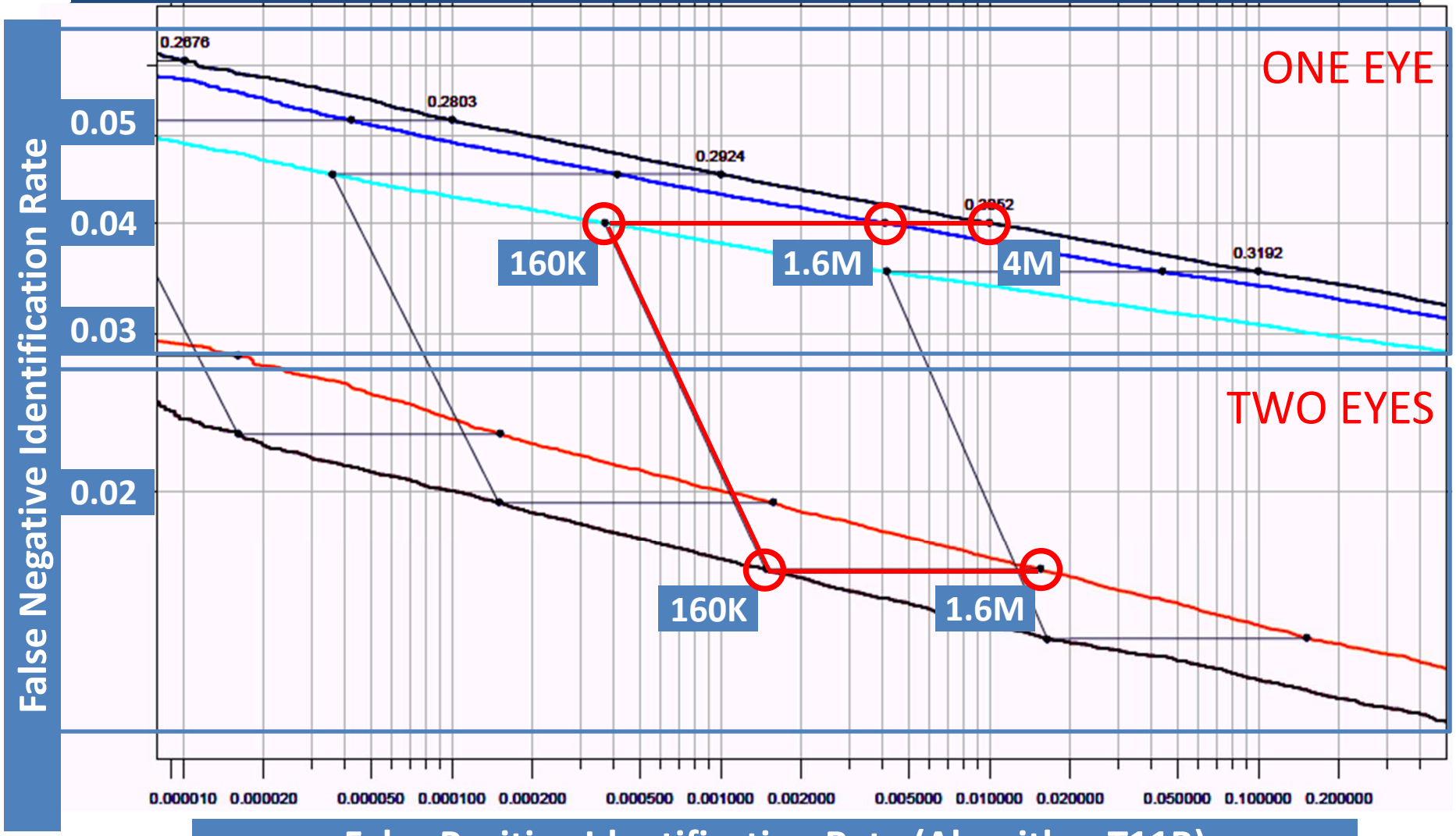
DET of Second Round Algorithms



Scalability :: Accuracy dependence on N



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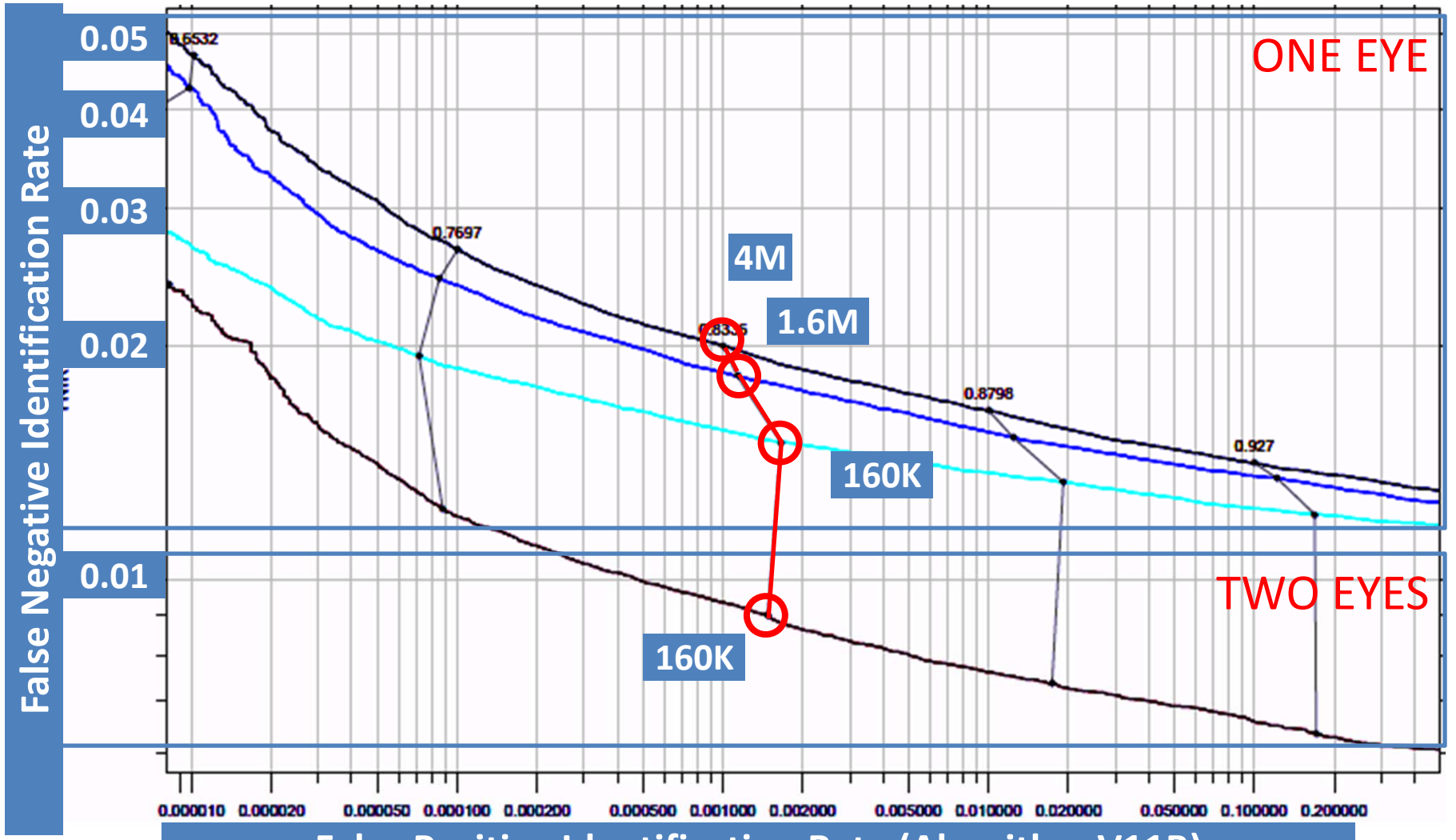
But … control of FPIR



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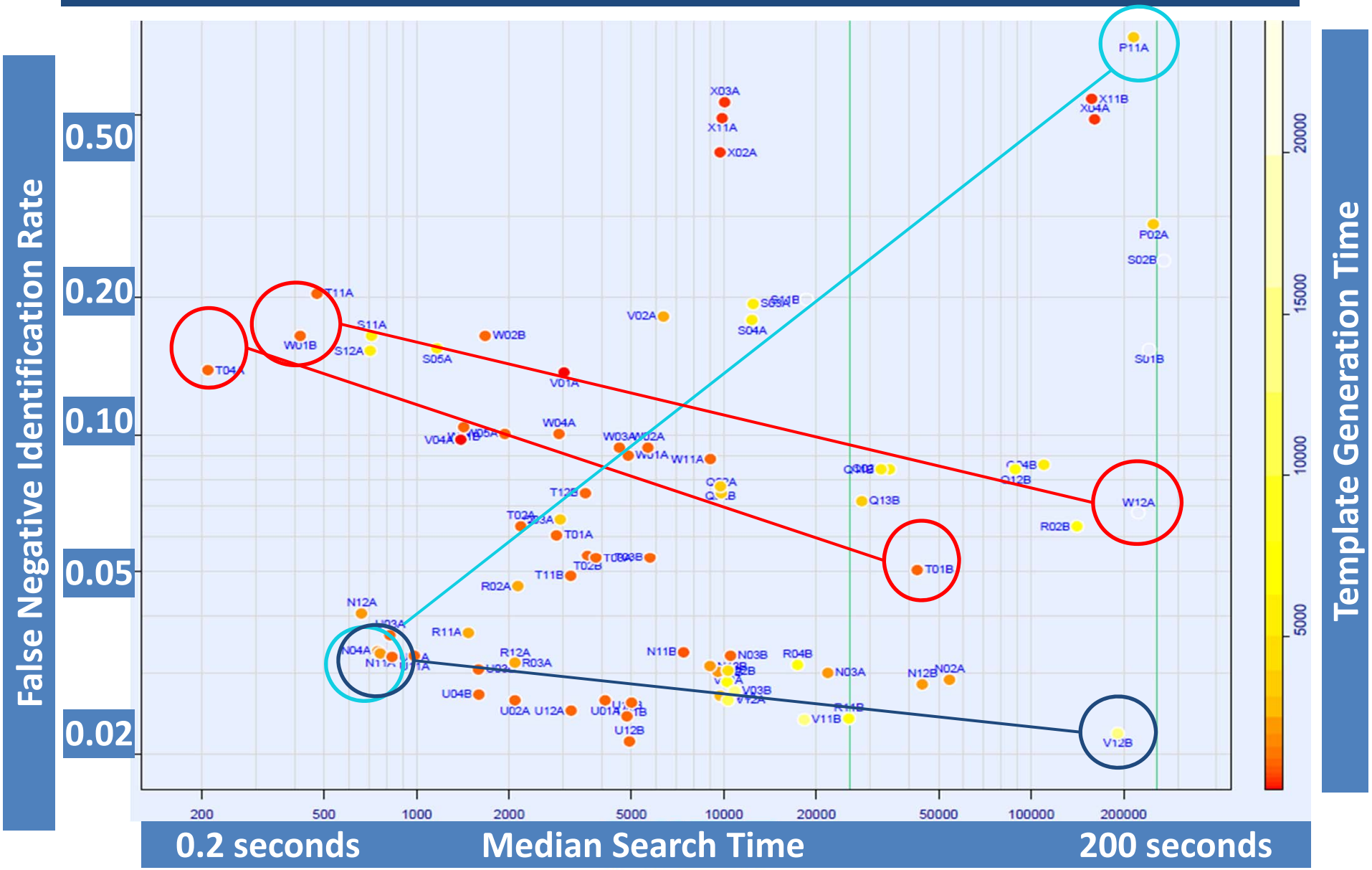
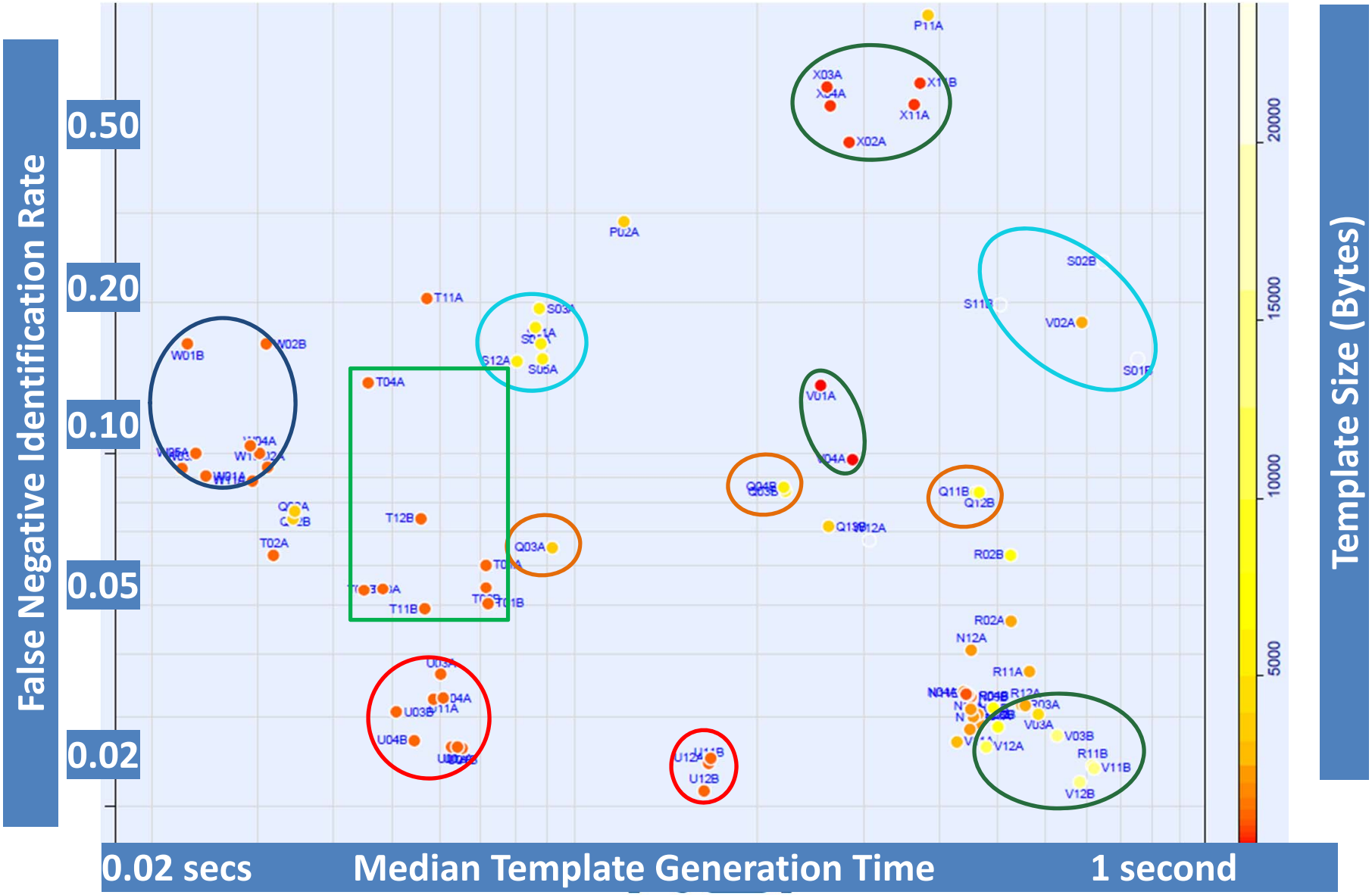
Tradespaces :: Intra + Inter Supplier



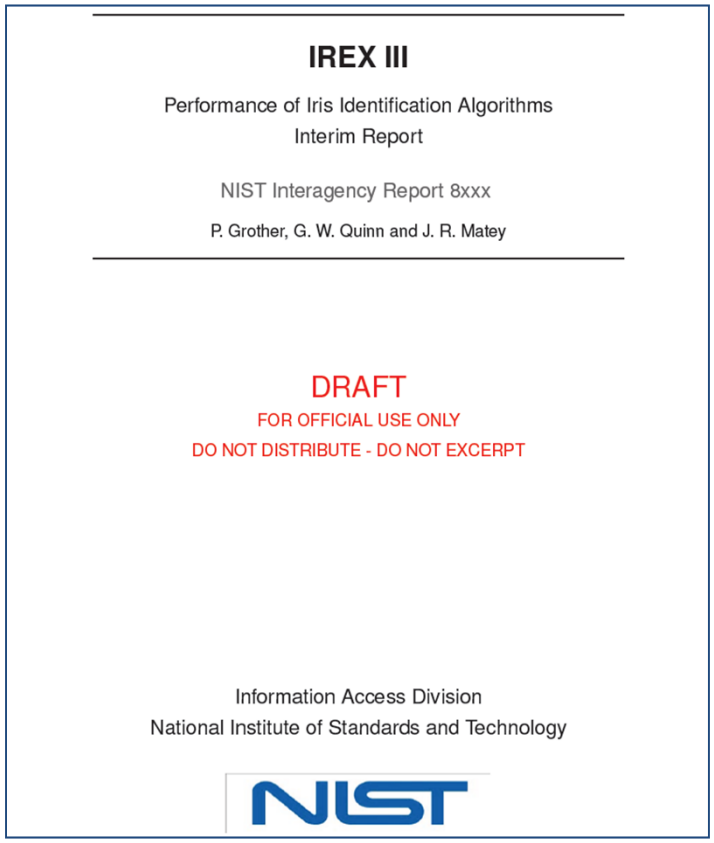
Tradespaces :: Intra + Inter Supplier



IREX III – Two Documents under Preparation

Evaluation Report :: Oct 2011

» NIST Interagency Report 8XXX



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Performance of Iris Identification Algorithms
Interim Report

NIST Interagency Report 8xxx

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Improving Iris Recognition

» NIST Interagency Report 8YYY

» Vignettes from empirical IREX III observations

» Guidance to planners, trainers, operators, deployers for real time quality control

- Potential content for ISO standard amendment.

» Guidance to developers for consideration in algorithm design

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Conclusions

- The industry has at least eleven algorithm providers
- Algorithms matter
  - Large variations in accuracy
- Iris can be fast, 10^7 mps
  - And slow, 10^4 mps
  - Speed can be traded for accuracy
  - Accuracy statements without speed measurements are limited
- The Daugman *iriscode* template is not the only one
  - Template sizes vary ~250B to 10KB, and up to 20K for search.
- FPIR = N FMR usually
  - But for others, FPIR = constant.
  - Threshold calibration curves
- Failure modes are algorithm dependent
  - Valuable to review high mates
  - Valuable to review low nonmates

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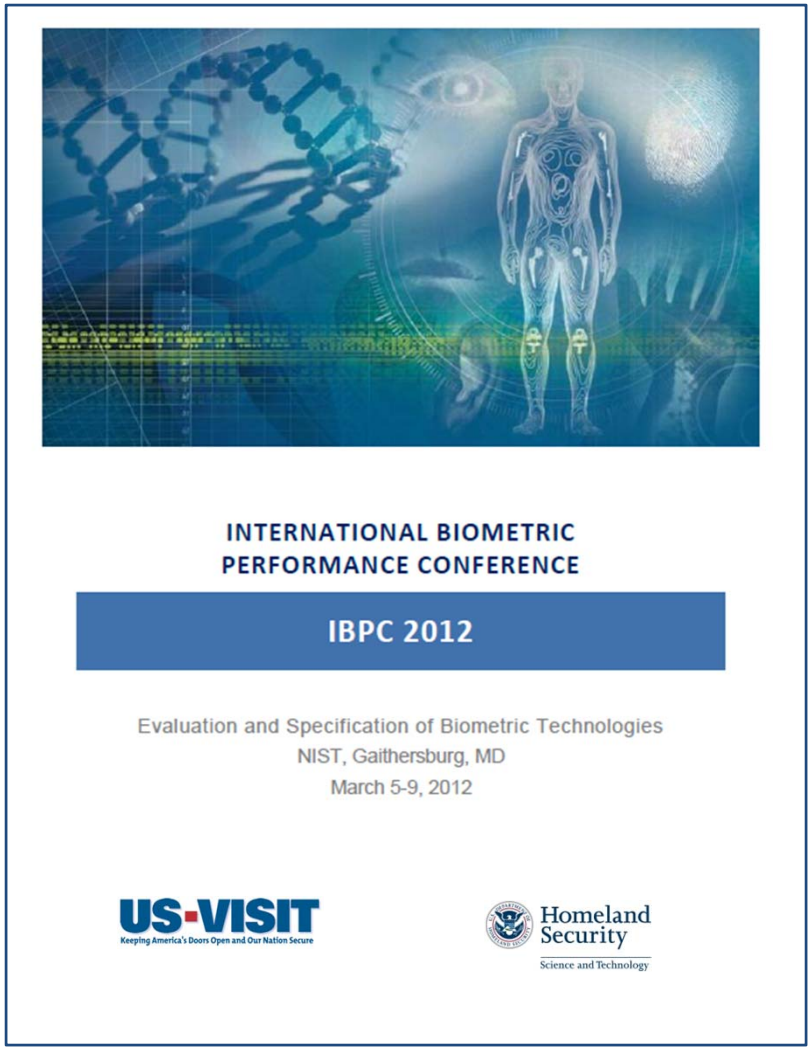
IBPC 2012



March 5-9, Gaithersburg, MD

- How to define, get, design for, measure, assure, performance in biometric systems.
- http://biometrics.nist.gov/ibpc2010
- 2012 website coming soon
- Contact ibpc2012@nist.gov

- See slides "*The Gulf Between Biometric Research and Biometric Deployments*", Terry Boult, 9/27/11

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Thank You

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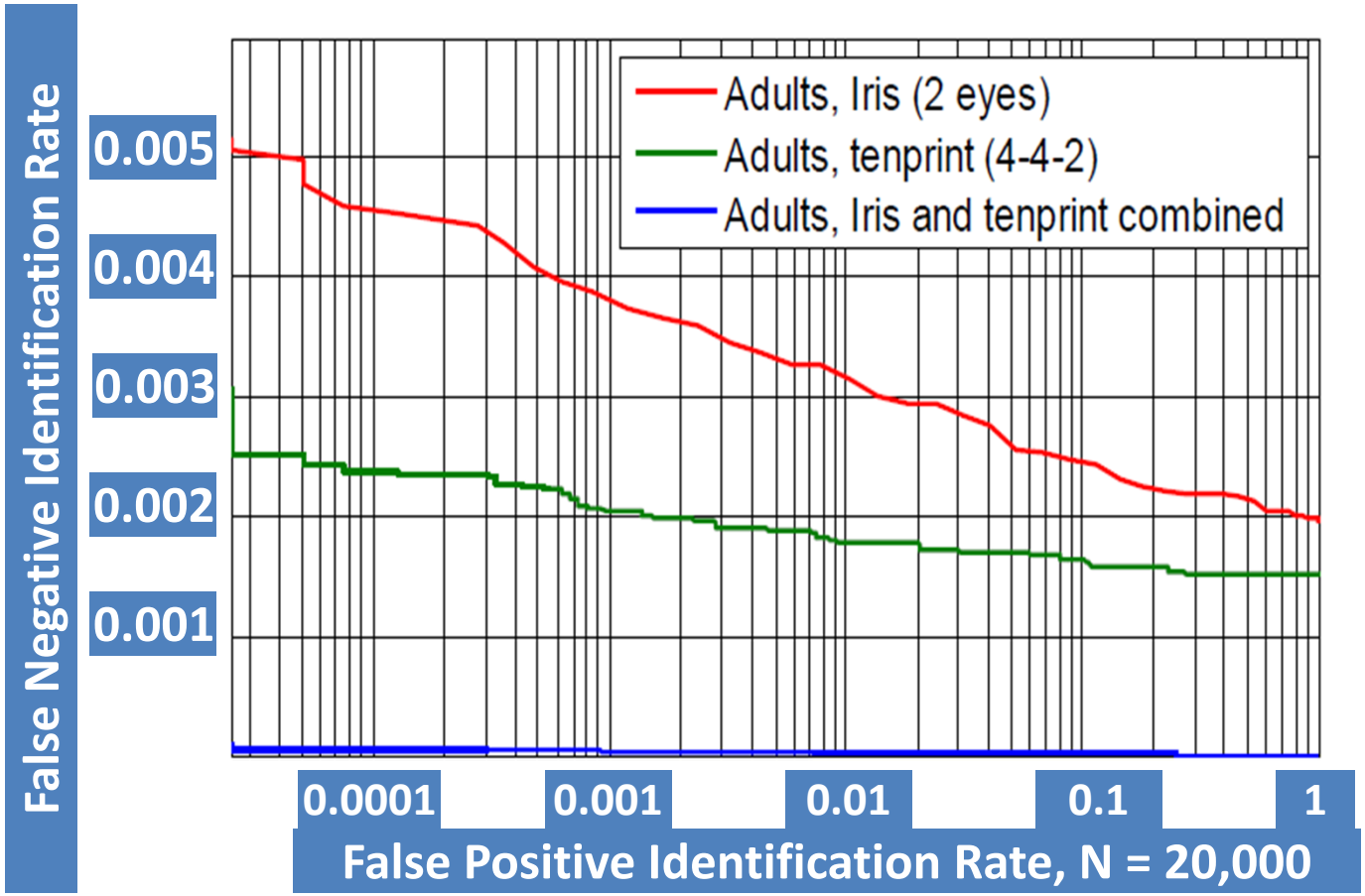
Published UID Accuracy, N = 20K



IREX III :: Two Eyes, 1.6M, JPEG

UID :: JPEG 2000

Under reasonable assumptions, UID and DoD are less than factor of two apart on FNIR at a common FPIR and N

Source: Annexure 3, UID Enrolment Proof-of-Concept Report, December 3, 2010.

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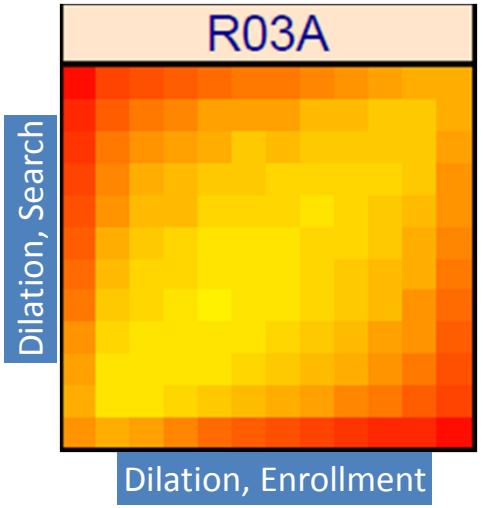
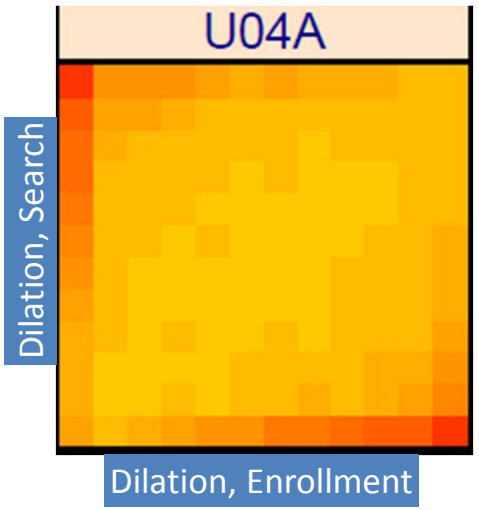
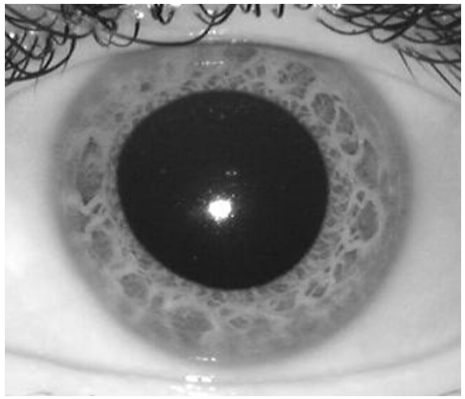
Dilation :: Outdoor operation implications

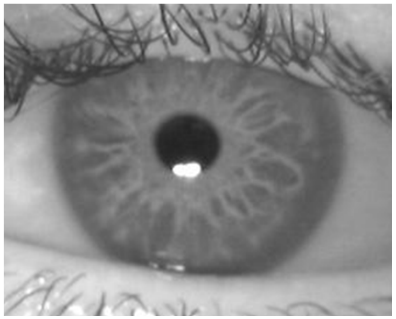


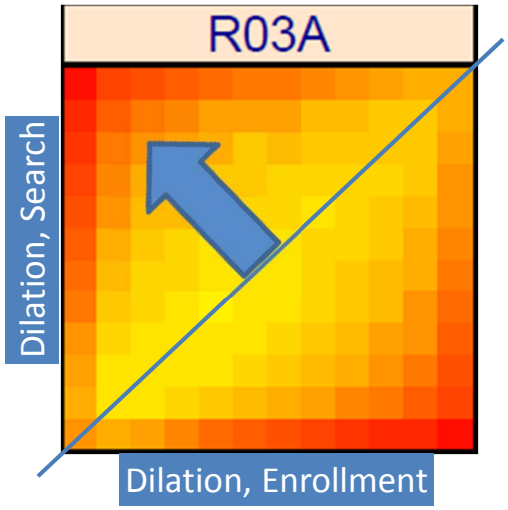


Dilation = R_p / R_i

» False rejection via
- High dilation
- Low dilation (i.e. constriction)
- **Cross condition**







$$\Delta D = 1 - \left(\frac{R_i^{(2)}}{R_i^{(1)}}\right)\left(\frac{R_i^{(1)} - R_p^{(1)}}{R_i^{(2)} - R_p^{(2)}}\right) = 1 - \frac{1 - D^{(1)}}{1 - D^{(2)}}$$

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False Positives

- Vanilla binomial
- $FPIR(\tau, N) = 1 - (1 - FMR(\tau))^N$
- Which, for small $FMR(\tau)$, gives
- $FPIR(\tau, N) \sim N\ FMR(\tau)$

False negatives

- For one enrolled mate
- $FNIR(\tau, N) = FNMR(\tau, 1)$

- To add a rank requirement in the FNIR definition, e.g. "HD = 0.2 and rank 5 or better", see
- Guide to Biometrics, Bolle et al. Springer 2003, or
- Grother + Phillips, *Models of large population recognition performance*, CVPR 2004

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