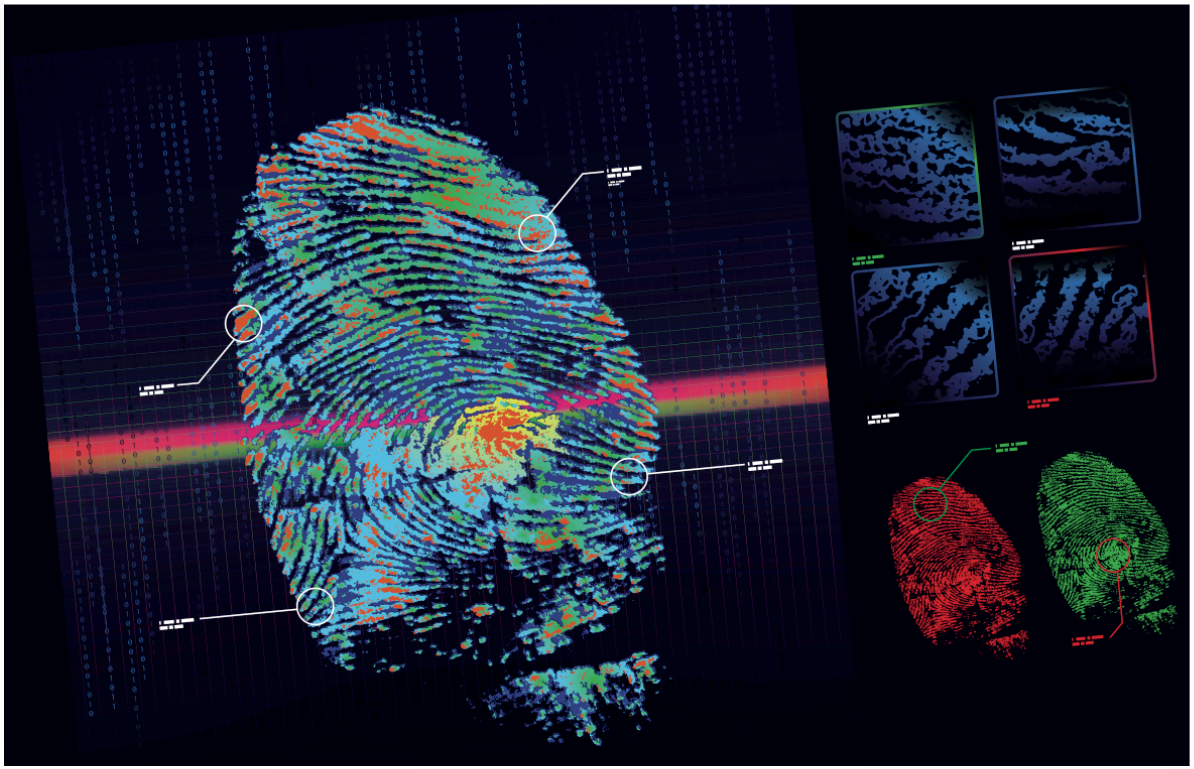


The Future of NFIQ

Elham Tabassi

March 1, 2010

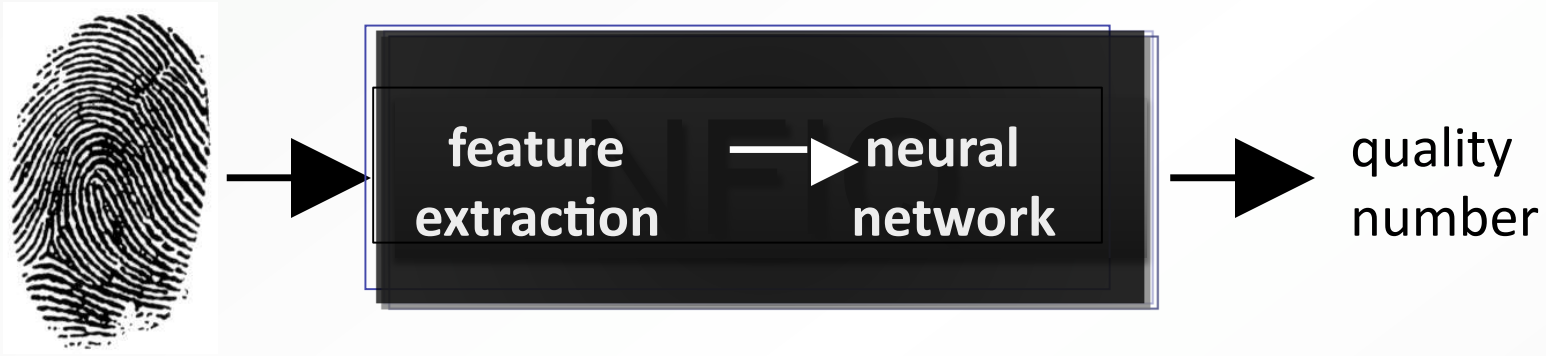
Agenda

- Welcome
  - Elham Tabassi
- NFIQ:: past, present, future
  - Elham Tabassi
- Retraining NFIQ based on BioDEV data
  - Markus Nuppeney (BSI)
- Break
- Discussion
  - All
- Wrap up
  - firm ideas on way forward

NIST fingerprint image quality

- NIST developed NFIQ in 2004
  - Open source
- Key innovation: quality as a rank statistic for performance
- NFIQ is a machine learning algorithm
  - Exploratory variables: image properties (minutiae, ridge density and clarity)
  - Response variable: separation of genuine and impostor comparison

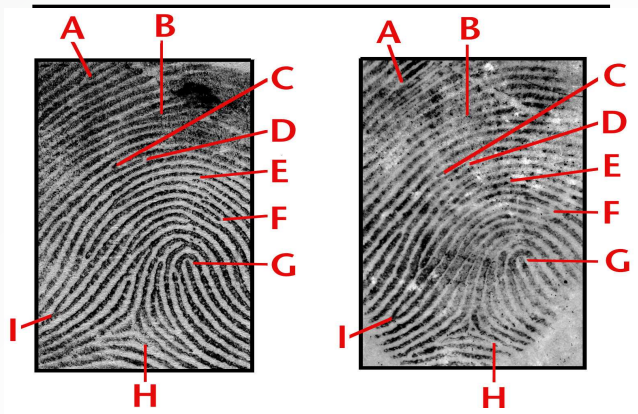
NFIQ

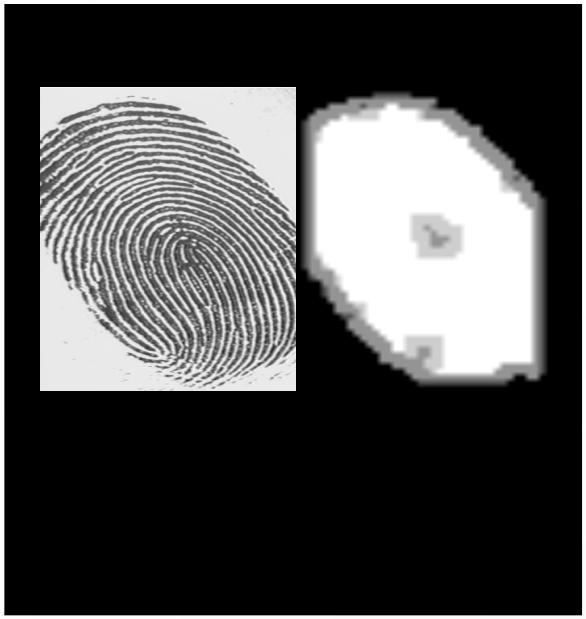


- **feature extraction**: computes appropriate signal or image fidelity characteristics and results in an 11-dimensional feature vector.
- **neural network**:classifies feature vectors into five classes of quality based on various quantiles of the normalized match score distribution.
- **quality number**: an integer value between 1(highest) and 5 (poorest).

NFIQ – feature vector

gray scale fingerprint image



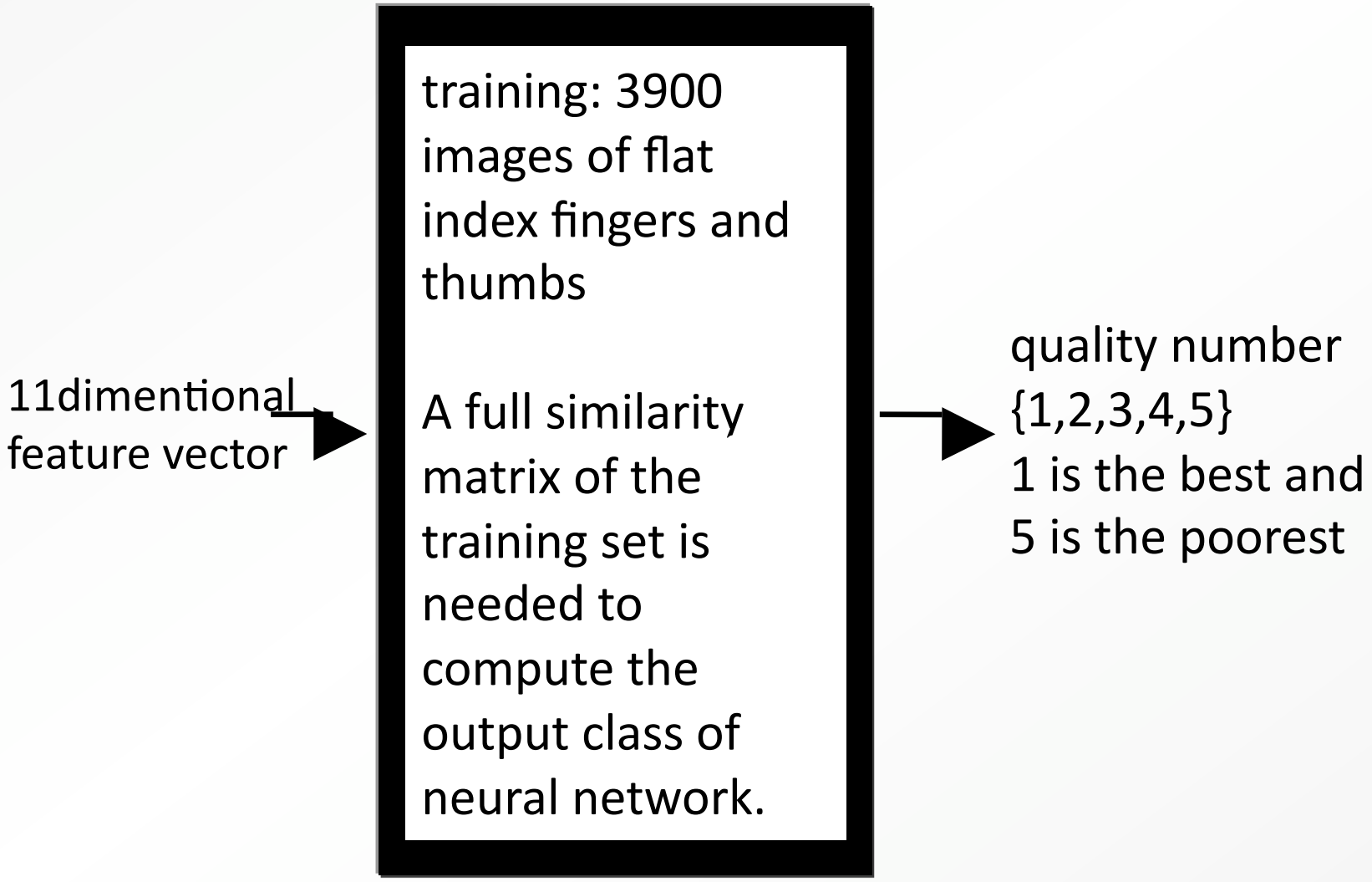


1 total # of minutia
2 #of min. with q≥.5
3 #of min. with q≥.6
4 #of min. with q≥.7
5 #of min. with q≥.8
6 #of min. with q≥.9

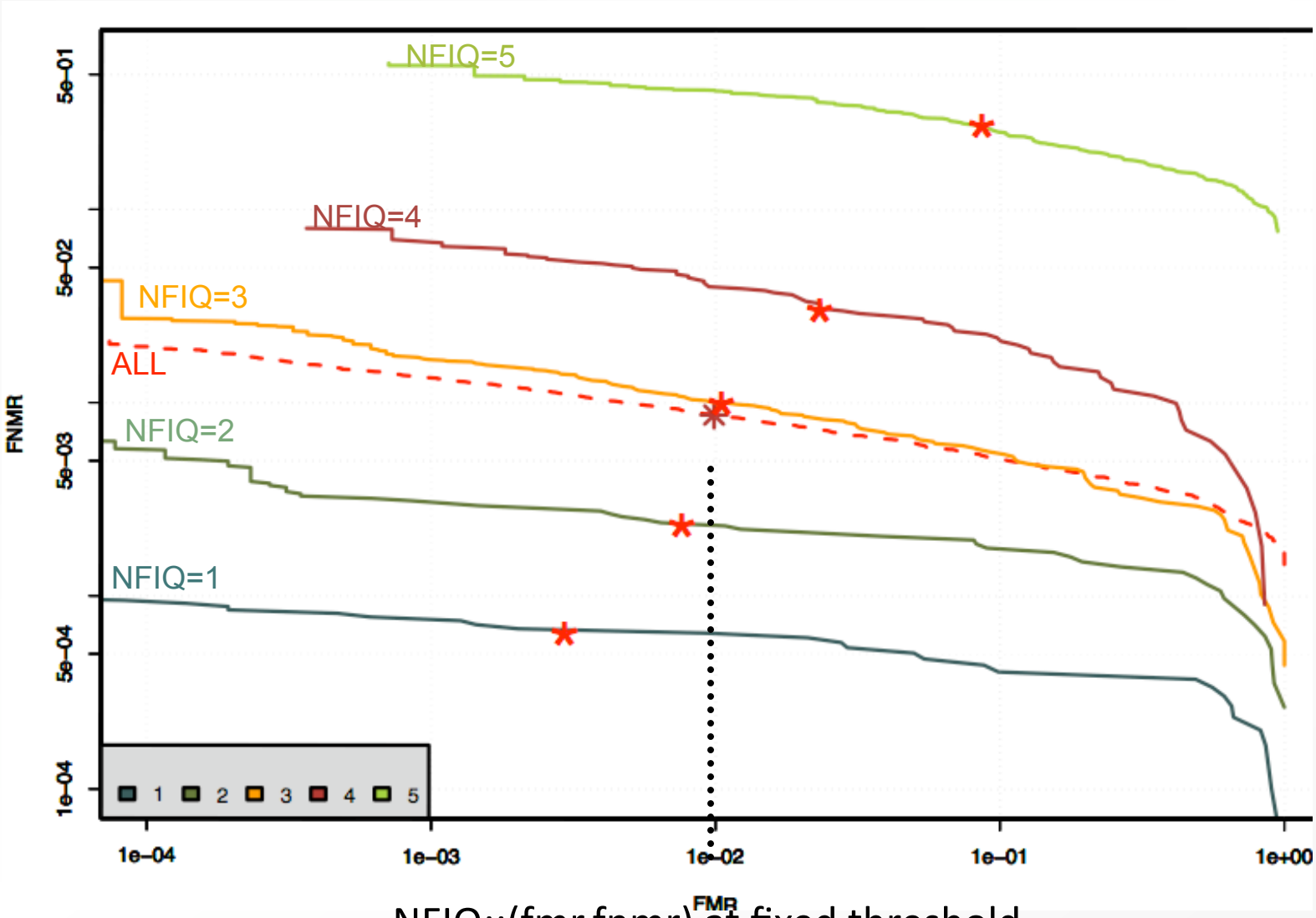
7 size of foreground
8 quality zone 1
9 quality zone 2
10 quality zone 3
11 quality zone 4

NIST Minutiae detector (mindtct of NBIS distribution) has been used for feature extraction.

NFIQ – training

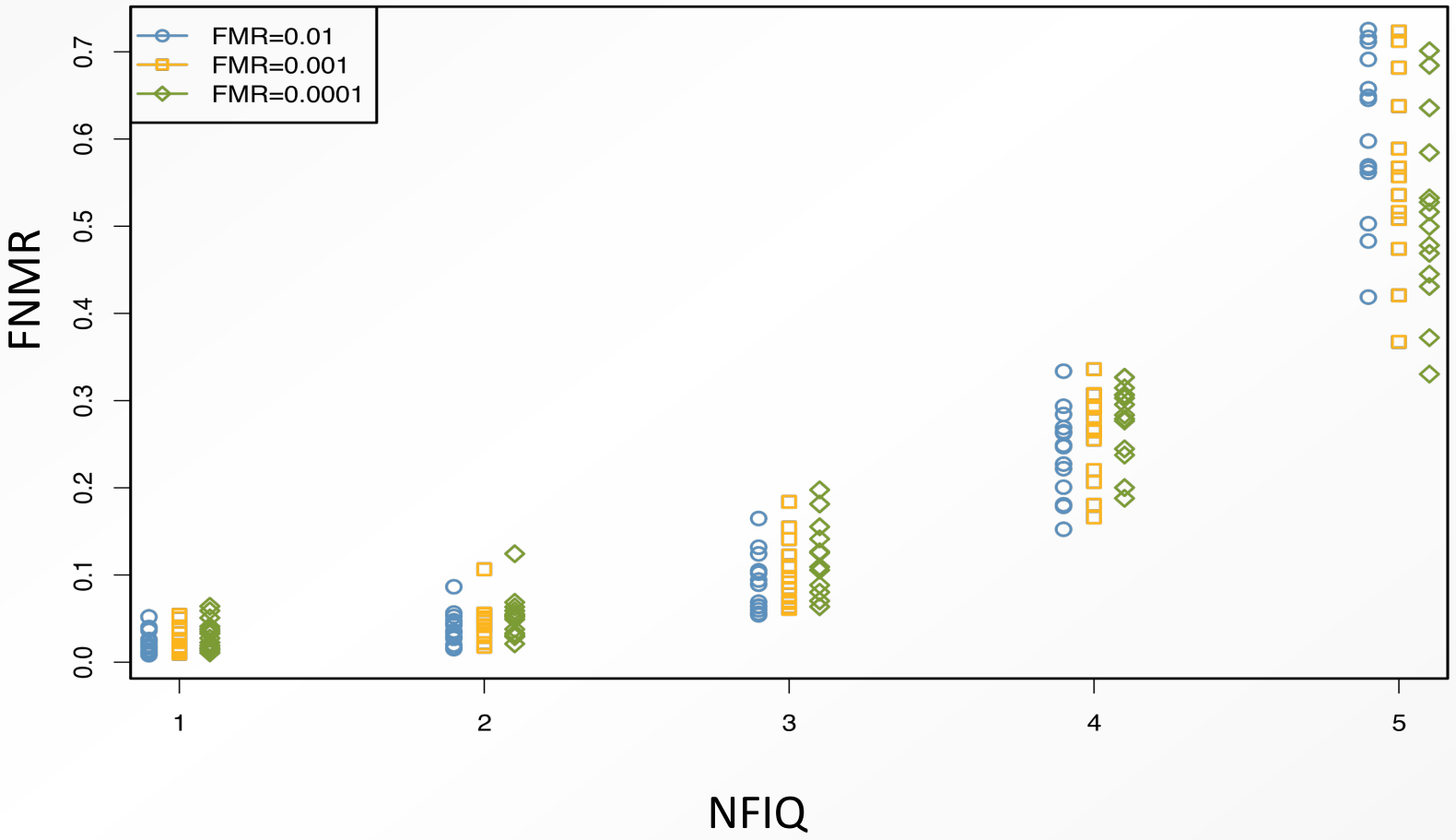


Quality: rank statistic for performance



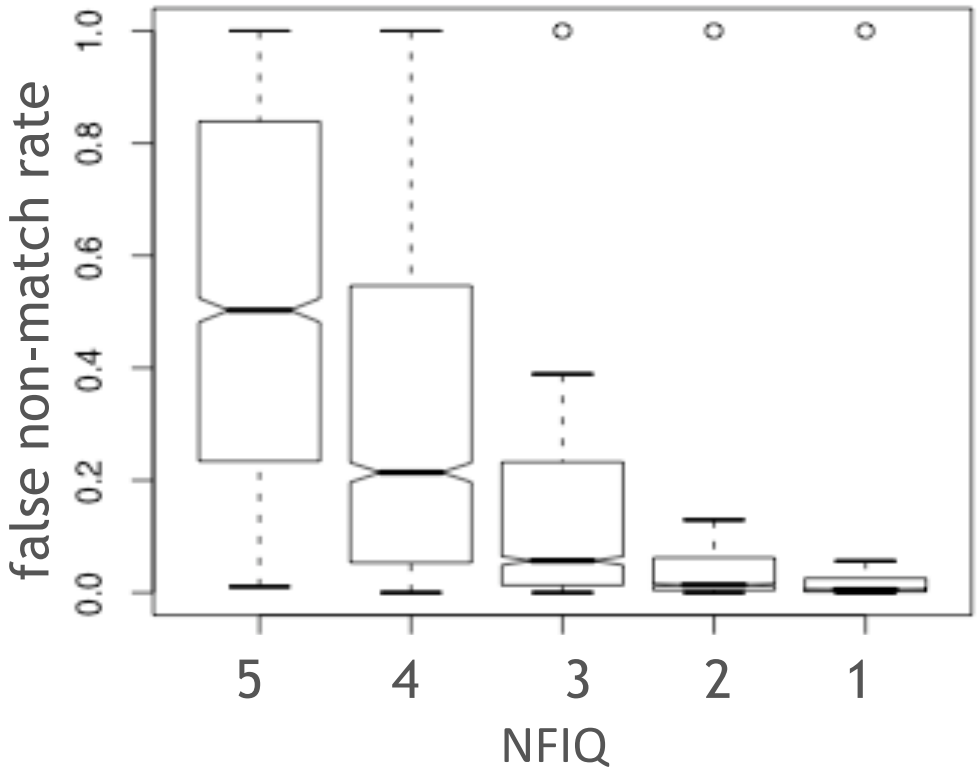
NFIQ::(fmr,fnmr) at fixed threshold

Dependence on matcher



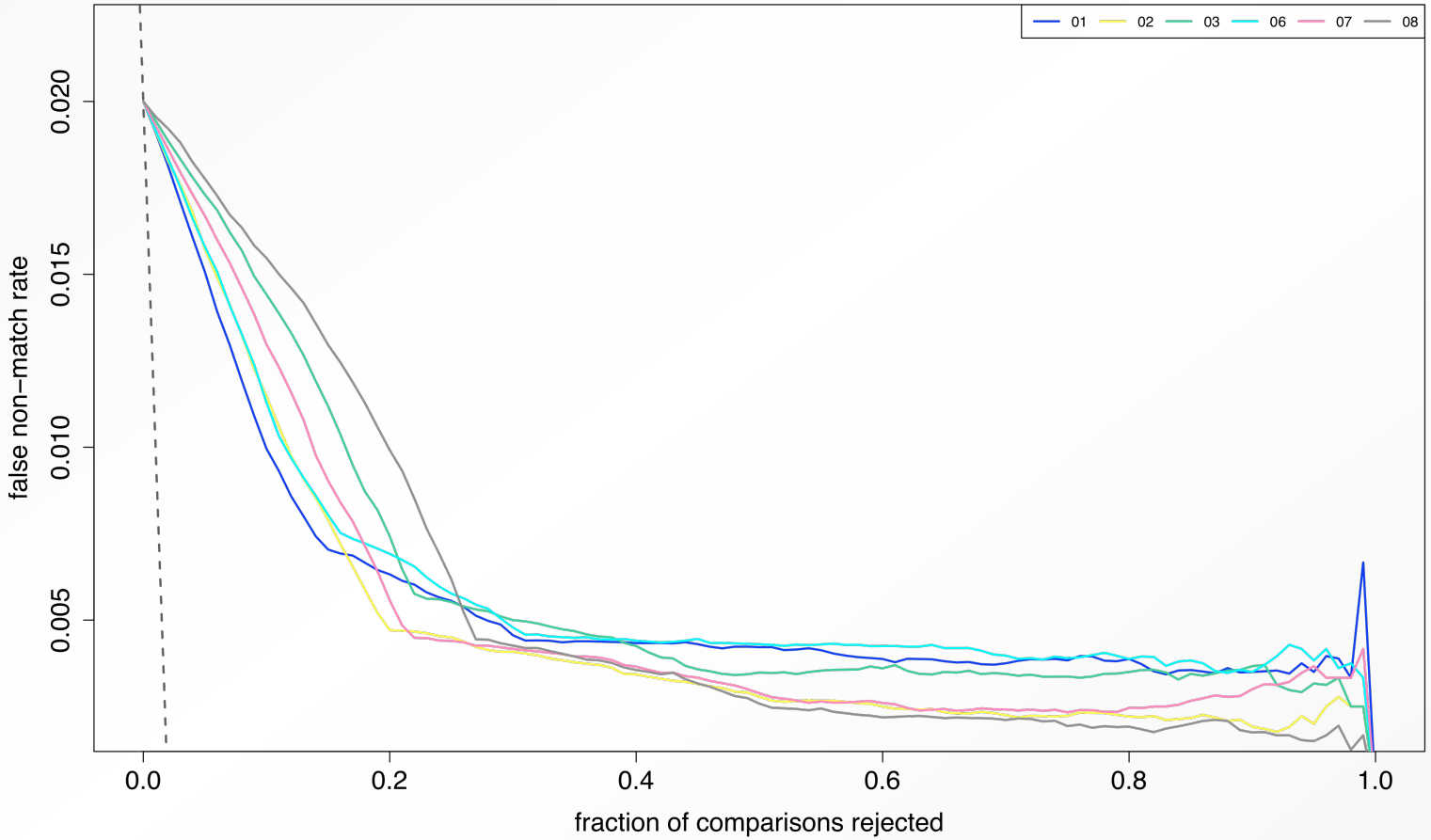
Each point corresponds to one algorithm.

How many levels?

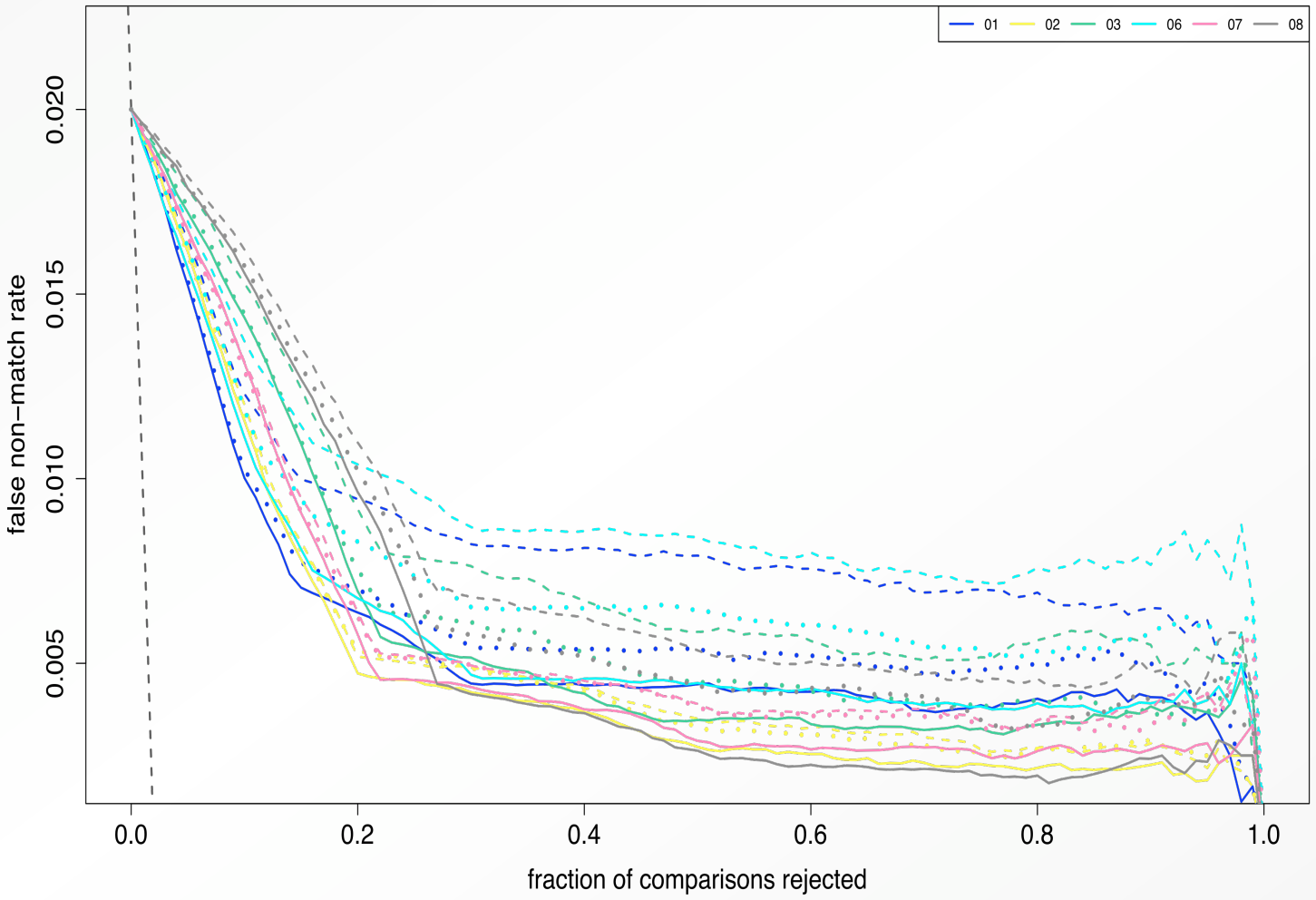


Statistically different level of performance

NFIQ rolled impressions -1



NFIQ rolled impressions -2



NFIQ – test of time

+

- Novel definition of biometric quality
  - performance related
  - accepted by the community
- Interoperability
  - uniform interpretation
  - tuned to a class of matcher
- Open source
- Extensively examined
  - by NIST and others
  - tools for quality summarization, slap, …

–

- Aging
  - recognition technology has advanced since 2004.
  - feature vector could be improved
- Efficiency
  - ~300 msec per image - not fast enough for real time
  - takes 4 times for 4-finger slap
- Not enough levels
  - Still statistically significant
- Not enough NFIQ 4

Options for NFIQ 2.0

- Do nothing!
- Incremental updates to NFIQ towards NFIQ 2.0
  - An improved NFIQ, generalized vanilla flavor
    - Improve feature extraction, training data, machine learning algorithm
    - done by NIST – open source
  - No ability to customize it to a particular application
  - Limited collaboration with industry
- Modular NFIQ 2.0
  - Plug-and-play feature vector
    - Improves efficiency in field operations
  - NIST does the training using its large sets of data
    - Generalized or specialized to a particular comparison algorithm
    - Feedback to vendors
  - Expands the marketplace of interoperable products
    - Calibrated quality in standardized range [0,100]

We like to hear your comments, suggestions.

Modular NFIQ 2.0

feature extraction → function approximator

quality Number [0,100]

by NIST (Clear box)

vendor supplied (black box)

Standardized feature + vendor proprietary (gray box)

By NIST Generalized (or maybe algorithm dependent)

We like to hear your comments, suggestions.

http://www.itl.nist.gov/iad/894.03/quality/

http://www.itl.nist.gov/iad/894.03/nigos/

DISCUSSION

Q1. dedicated or generalized quality?

- ⚀ generalized, matchers/extractors may change.
- ⚁ dedicated – the deployed matcher / extractor is all that is important.
- ⚂ both – each had its own utility.
- ⚃ I don't care.

Q2. NFIQ 2.0 or not?

- Not – never liked NFIQ anyhow!
- NFIQ 1.0 was OK – but no need for NFIQ 2.0.
- Yes – it is timely.
- Abstain.

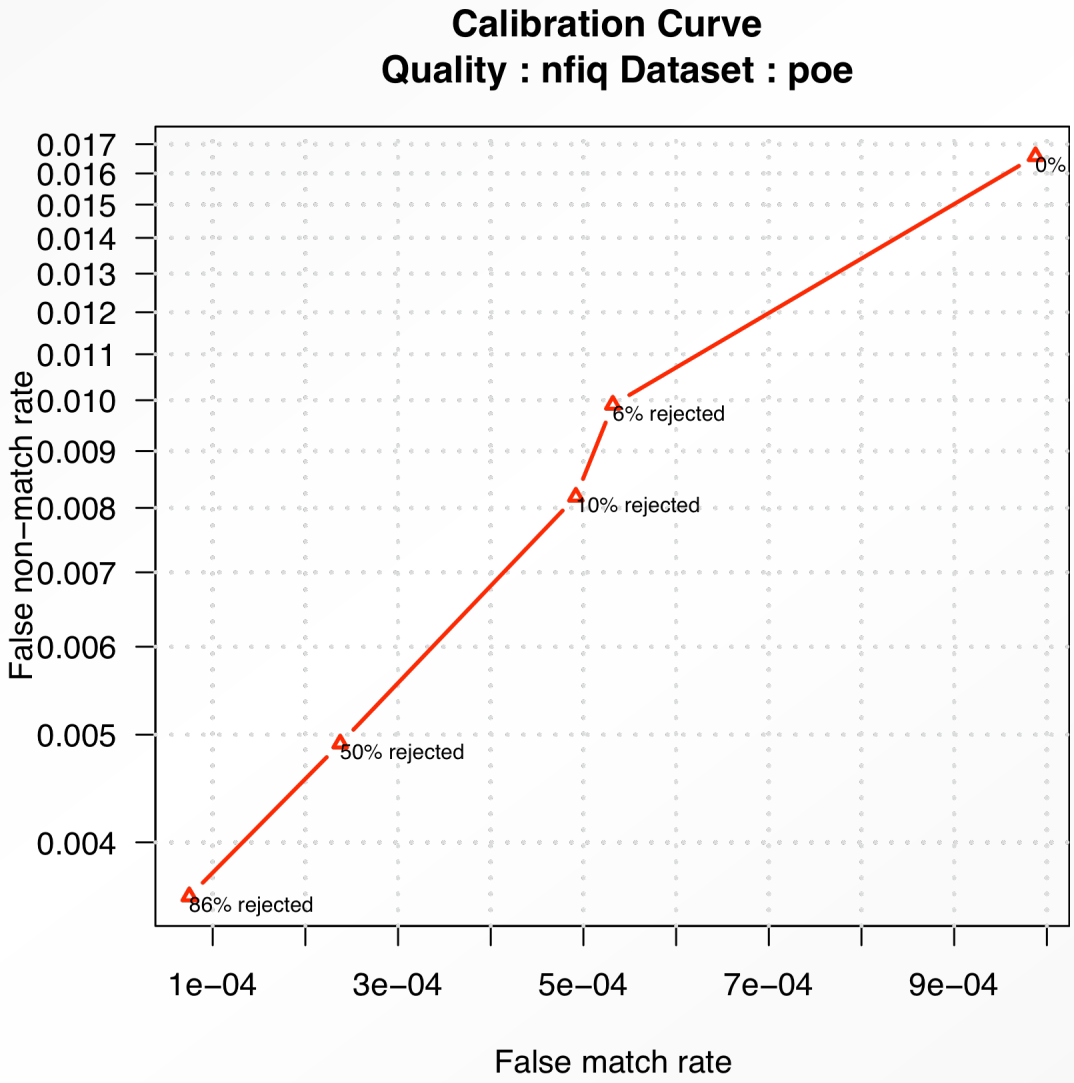
Q3. modular NFIQ 2.0?

- ⚀ makes sense
- ⚁ bad idea
- ⚂ complicated
- ⚃ don't care

Q4. the most reasonable option is …

- option 1 - do nothing
- option 2 – vanilla flavor, generalized, open source NFIQ 2.0
- option 3 – modular NFIQ
- none of the above
- don't care

Calibration Curve: Error vs reject : NFIQ



NFIQ rolled impressions - 3