



Homeland  
Security

# Expanding Face Image Quality to Include More Use Cases

*International Face Performance  
Conference*

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Futures Identity

Office of Biometric Identity Management (OBIM)

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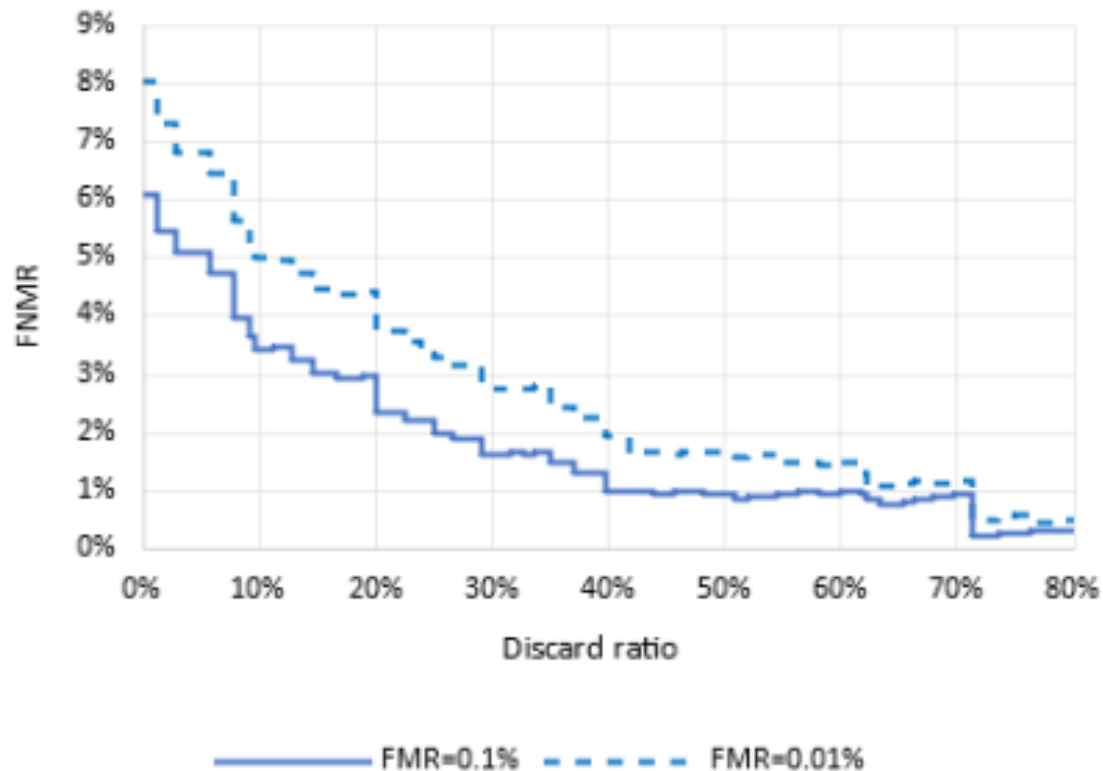
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Office of the Under Secretary for Management

- **Purpose**

- To explore broadening of the current concept of “biometric quality” to include use cases beyond collection of canonical data.

## FNMR vs Discard Ratio Used since 2007




# Assumptions of FNMR vs Discard Rate Approach

ALL must apply

1. Quality of a comparison score can be attributed singly to either the probe or the reference sample.
2. Match/non-match decisions are made on the basis of a single comparison score.
3. Policies allow samples to be discarded.
4. FMR is either not of interest or not dependent on quality
5. There exists a canonical representation of the biometric sample.
6. The database contains canonical references such that the deviation of probe samples from the canonical requirements can be used as a proxy for quality (utility).

# Conformance as Proxy for Quality

- Reference database contains samples with canonical representations
  - Face ISO/IEC 39794-5 Annex D
  - Contact Fingerprint ISO/IEC 39794-4 Annex D
  - Iris ISO/IEC 39794-6 Annex D
- Reasonable assumption: mated images collected under similar constraints are likely to correctly match
- 
- Departure from canonical requirements can be used as a proxy for quality (utility)

ANY of the following apply:

1. Quality of a comparison score is computed using a method other than lowest sample quality.
2. Decisions are made on the basis of multiple comparison scores, including use of Bayesian techniques.
3. Policies do not allow for the discarding of samples.
3. Dependency of FMR on quality is of interest
4. No canonical representation of the biometric sample exists.
5. The reference database does not contain references compliant with canonical requirements.

# Mappings: 2 samples to 1 comparison

Function Name	Function F
Minimum	$Q(s_{ij}) = \min(q_i^{(1)}, q_j^{(2)})$
Maximum	$Q(s_{ij}) = \max(q_i^{(1)}, q_j^{(2)})$
Sum	$Q(s_{ij}) = q_i^{(1)} + q_j^{(2)}$
Mean	$Q(s_{ij}) = (q_i^{(1)} + q_j^{(2)})/2$
Hyperbolic Mean	$Q(s_{ij}) = [0.5/q_i^{(1)} + 0.5/q_j^{(2)}]^{-1}$
Absolute Difference	$Q(s_{ij}) =  q_i^{(1)} - q_j^{(2)} $
Probe Quality Only	$Q(s_{ij}) = q_i^{(1)}$



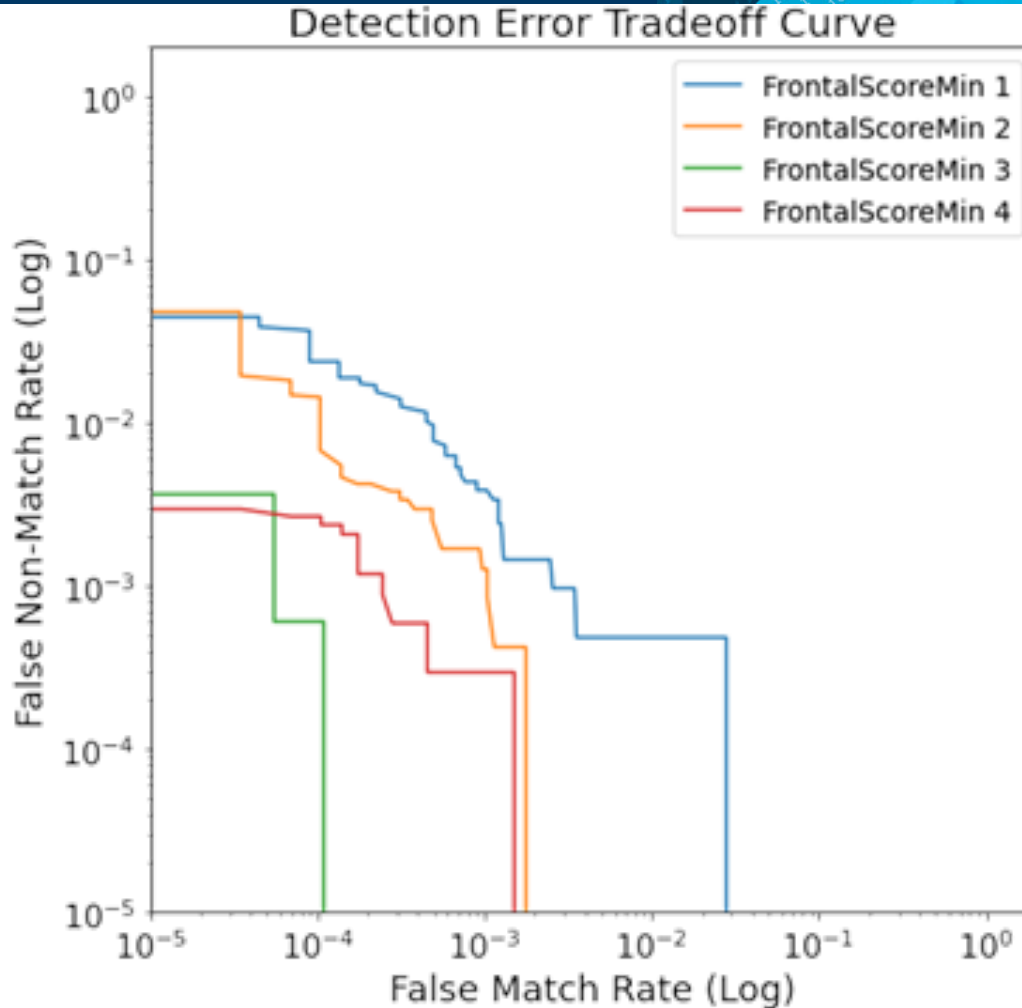
# Mapping Sample Values to Comparison

- A biometric comparison develops a metric expressing similarity or difference between probe and reference.
- If both probe and reference have a quality value, then there are two quality values for each comparison
- Comparisons have utility as measured by error rates
- How to determine a single quality value to assign to each comparison



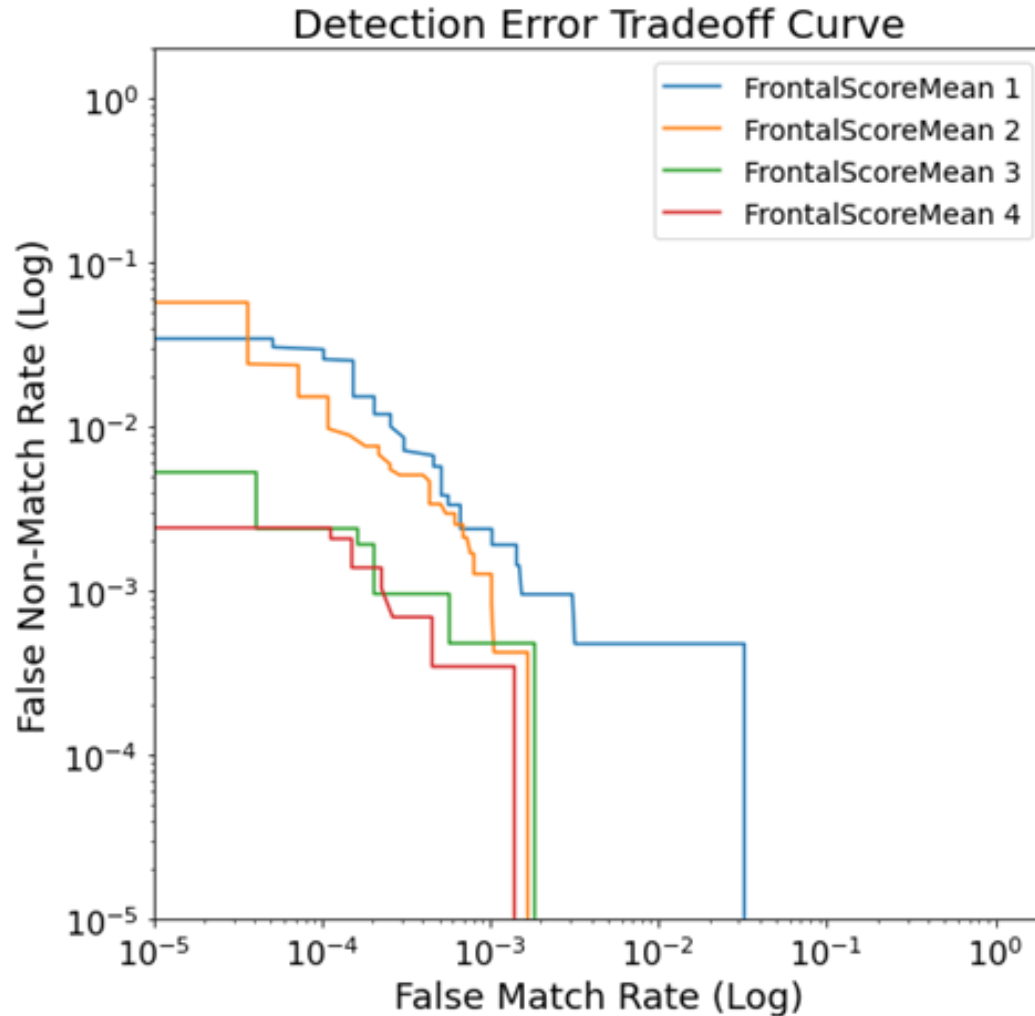
- Two experiments: mated and non-mated
- For each experiment, partition comparison scores into bins based on single **comparison quality** metric using  $F$  chosen from above
- For each bin, plot DET
- If multiple comparison quality metrics are available, repeat for each

# Quality 1; F=minimum



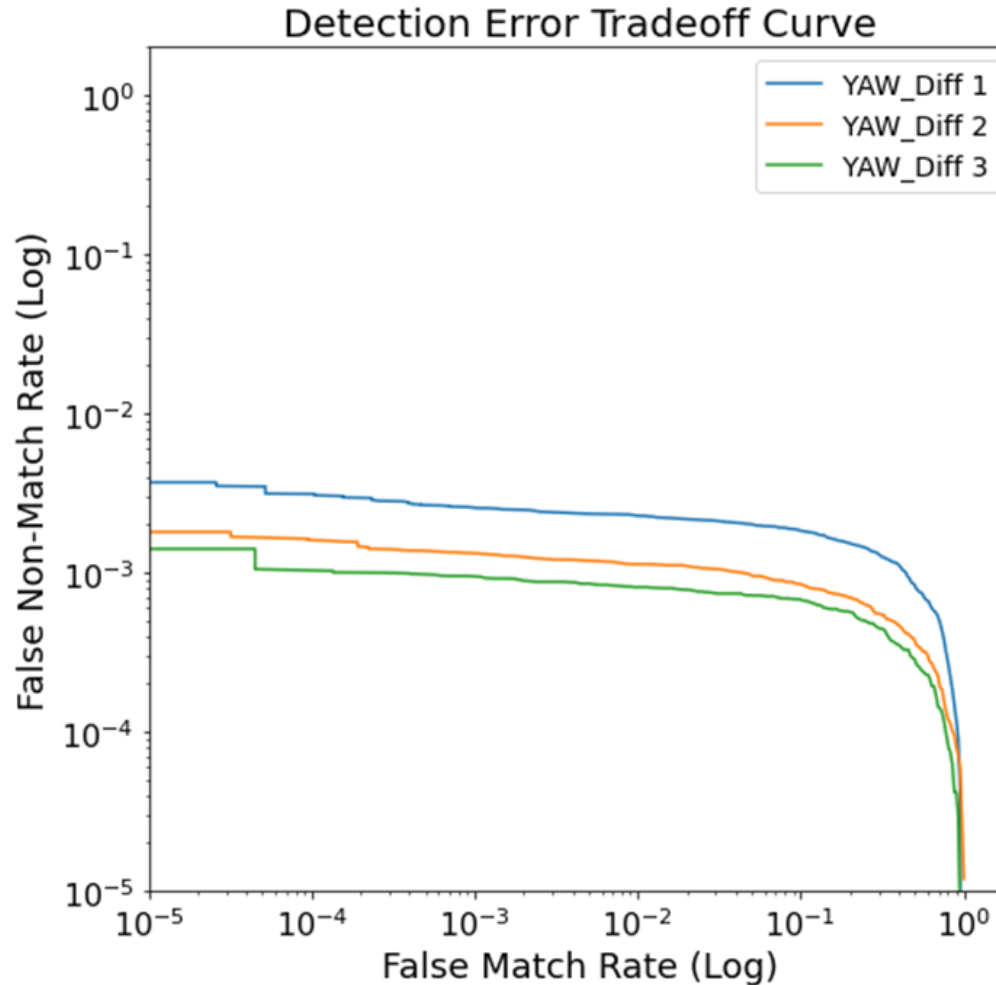
DET curves created from facial image scores and quality data computed using Minimum Function and 25/50/75/100 binning.

# Quality 2: F= mean



DET curves created from facial image scores and quality data computed using Mean Function and 25/50/75/100 binning

# Quality 3; $F = |\Delta|$



DET curves created from facial image scores and quality data computed using (yaw) difference function and 25/75/100 binning



- We have assigned a quality to a comparison score allowing us to predict FNMR/FMR performance for that comparison
- This will allow:
  - Comparison dependent thresholds
  - Multi-comparison fusion
- Research question: If multiple quality-based DETs were available for a single comparison, could an improved estimate of error rate tradeoffs as a function of comparison score be developed?



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