



DoD ABIS: Quality Evaluation of Operational Multi-Modal Biometric Data

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DoD Biometrics



Outline



- Motivation/Problem Statement
- Operational Setting
- Multi-Modal Biometric Data
 - Fingerprint
 - Face
 - Iris
- Challenges



Motivation

- Quality of data affects system performance
 - Processing time
 - Validity of results
- Quality-adaptive processing
 - Thresholds sensitive to quality of probe & gallery samples
- Multi-modal fusion
 - Quality drives order of processing
 - Quality a factor into score/decision combination
 - Quality-sensitive thresholds



Operational Setting



- DoD BMO Biometric Collection SOP
 - 10(14) finger images, 5 face photos, 2 iris images
- Overworked, under-trained, collectors
 - often under stressful (life-threatening) conditions
 - often in a harsh environment (lighting, temperature, etc.)
- Substantial amount of legacy data (10+ years old)
 - paper fingerprint cards that have been exposed to severe environmental conditions
 - scanned images of Polaroid photos that have been stapled and exposed to the elements
- Highest reliability desired
 - National security at stake



Fingerprint



- Evaluation methods
- Data sample
- Quality findings



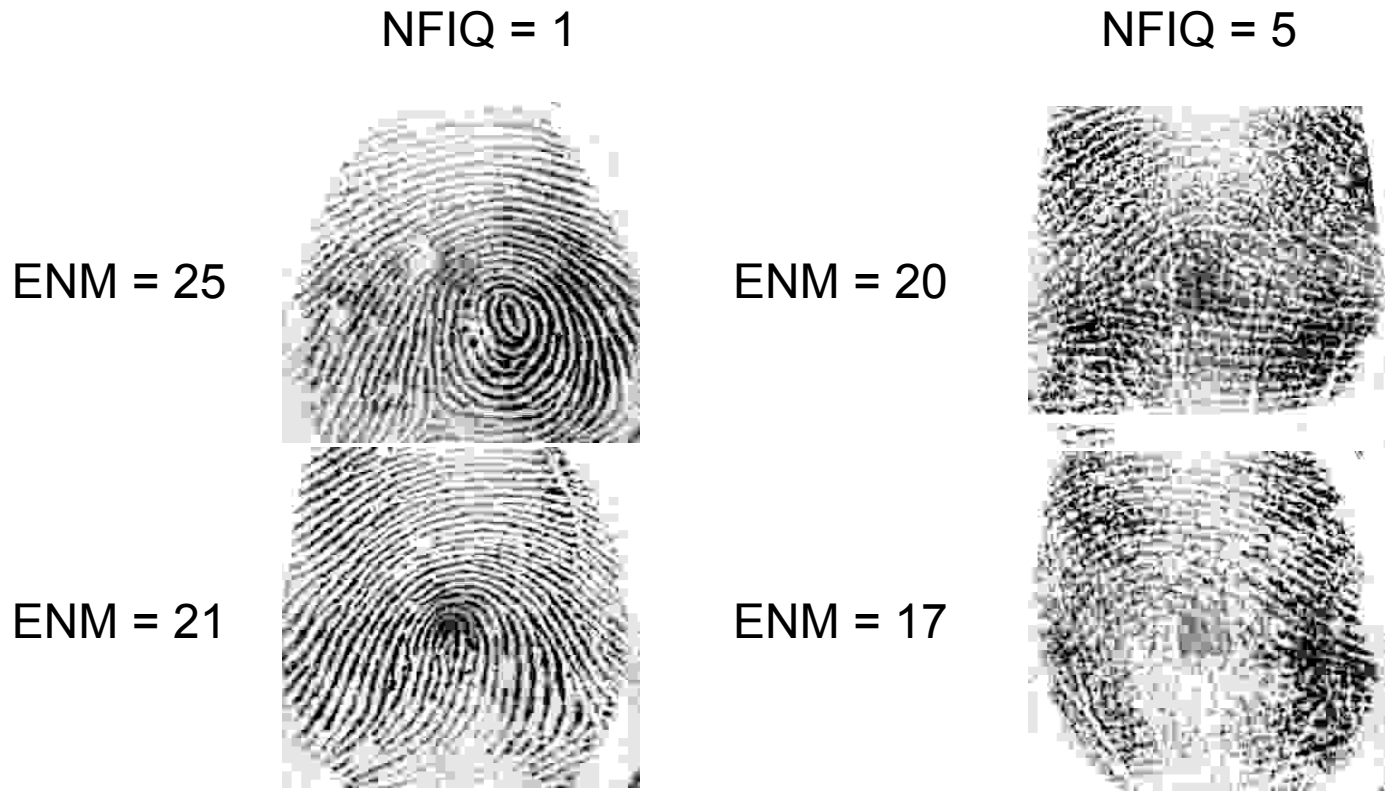
Finger Image Quality Evaluation



- **NFIQ** - NIST Finger Image Quality
 - Range of 1-5
 - Related to minutia matcher performance
- **FIQM** - Finger Image Quality Measurement
 - Range of 0-100
 - Related to human perception
- **ENM** - Equivalent Number of Minutia
 - Range of 0-85
 - Related to quality of print near each minutia and its neighbors

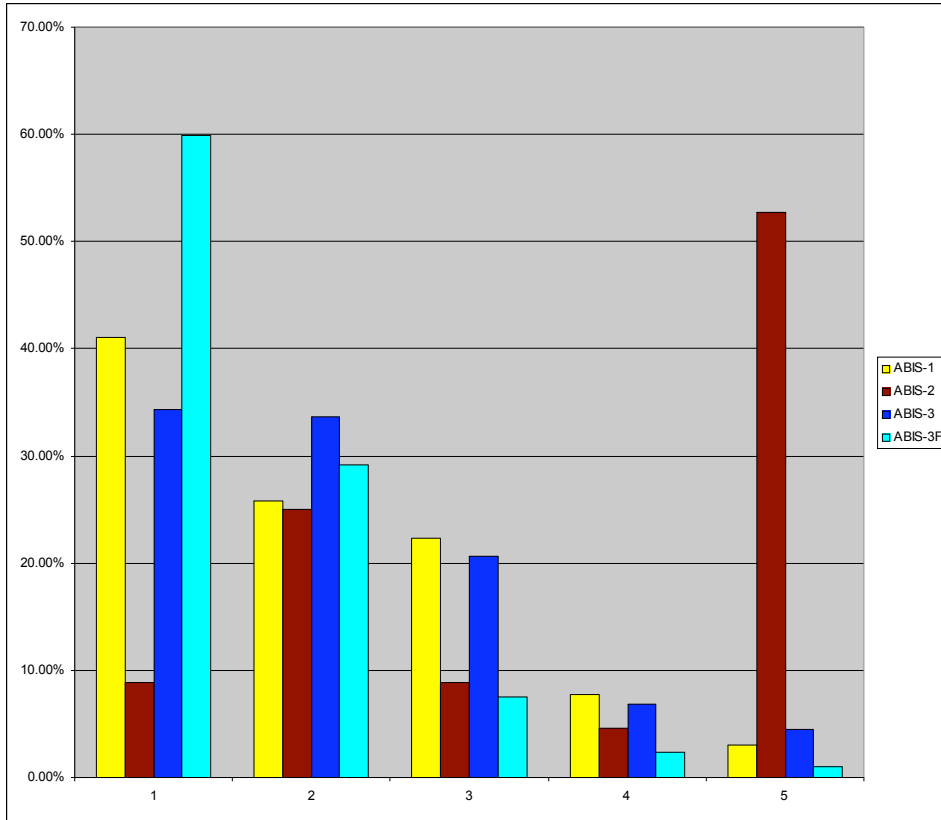


Quality Measures

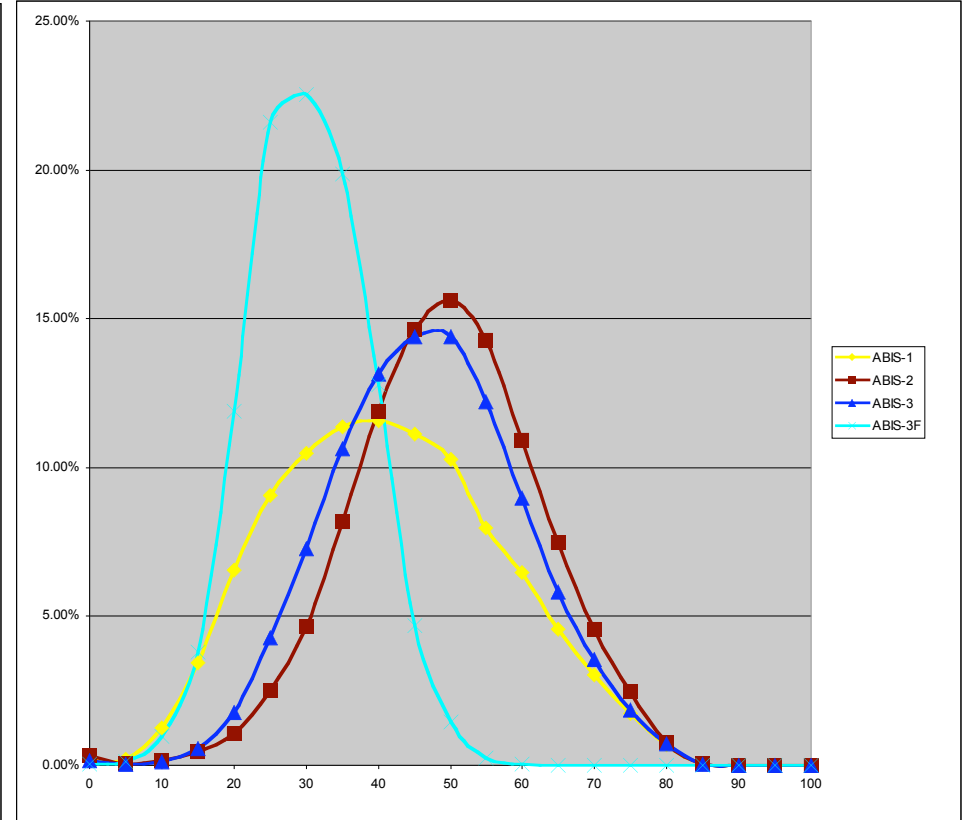




Finger Quality Findings I



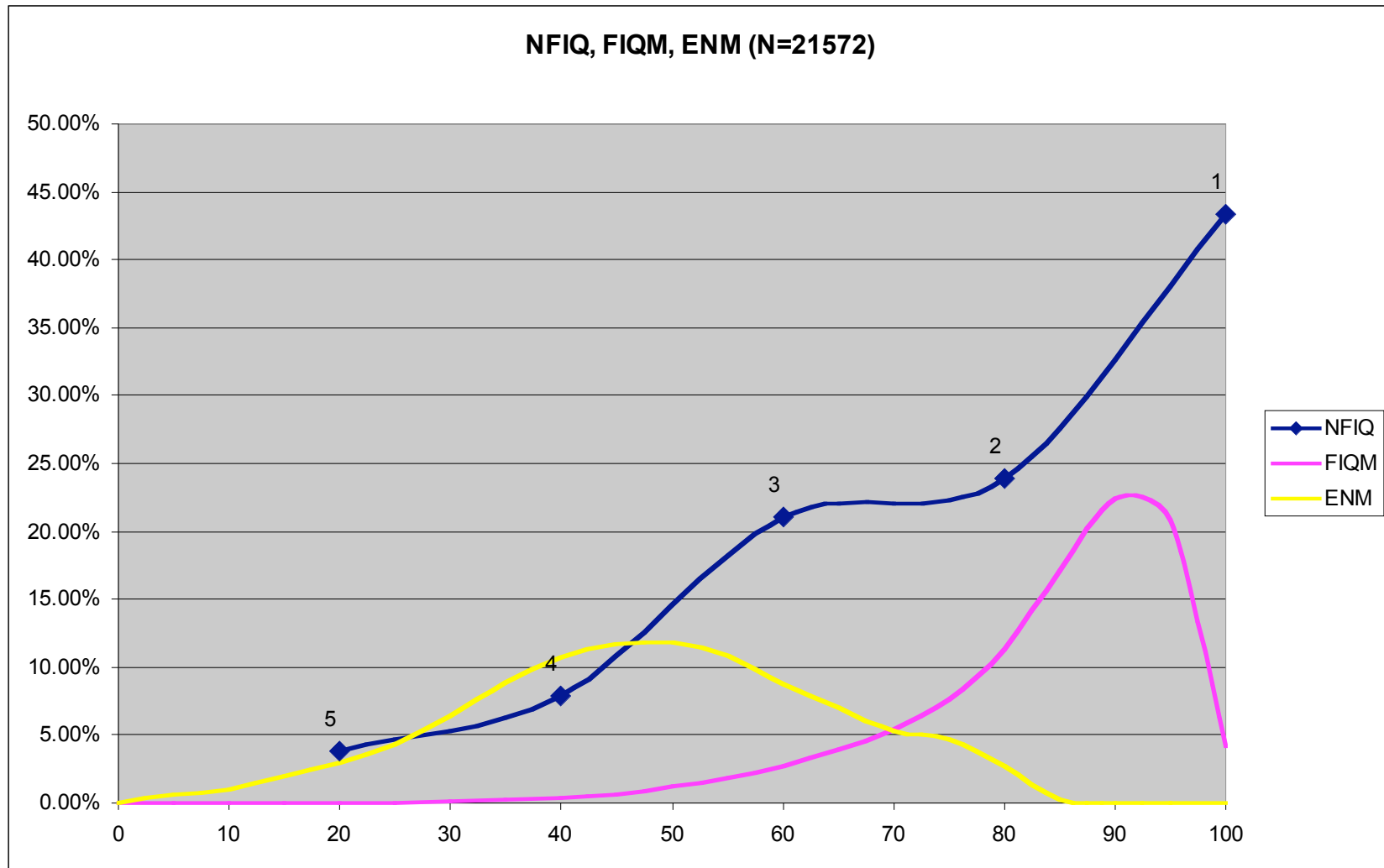
NFIQ



ENM



Finger Quality Findings II



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Finger Quality Correlation?



	NFIQ	ENM	ENM per Minutia	FIQM
NFIQ	1			
ENM	-0.355	1		
ENM per Minutia	-0.588	0.782	1	
FIQM	-0.775	0.434	0.687	1



Face



- Evaluation methods
- Data sample
- Quality findings



Face Image Quality Evaluation

- Identix Facelt Quality Assessment
 - 11 dimensions
 - darkness, brightness, exposure, focus, resolution, cropping, glasses, faceness, contrast, texture, and faceFindingConfidence
 - Overall Quality computed as:
 - minimum(darkness, brightness, focus, resolution, cropping, faceness, contrast)
 - 0.0-3.9 : Bad
 - 4.0-6.9 : Fair
 - 7.0-10.0 : Good

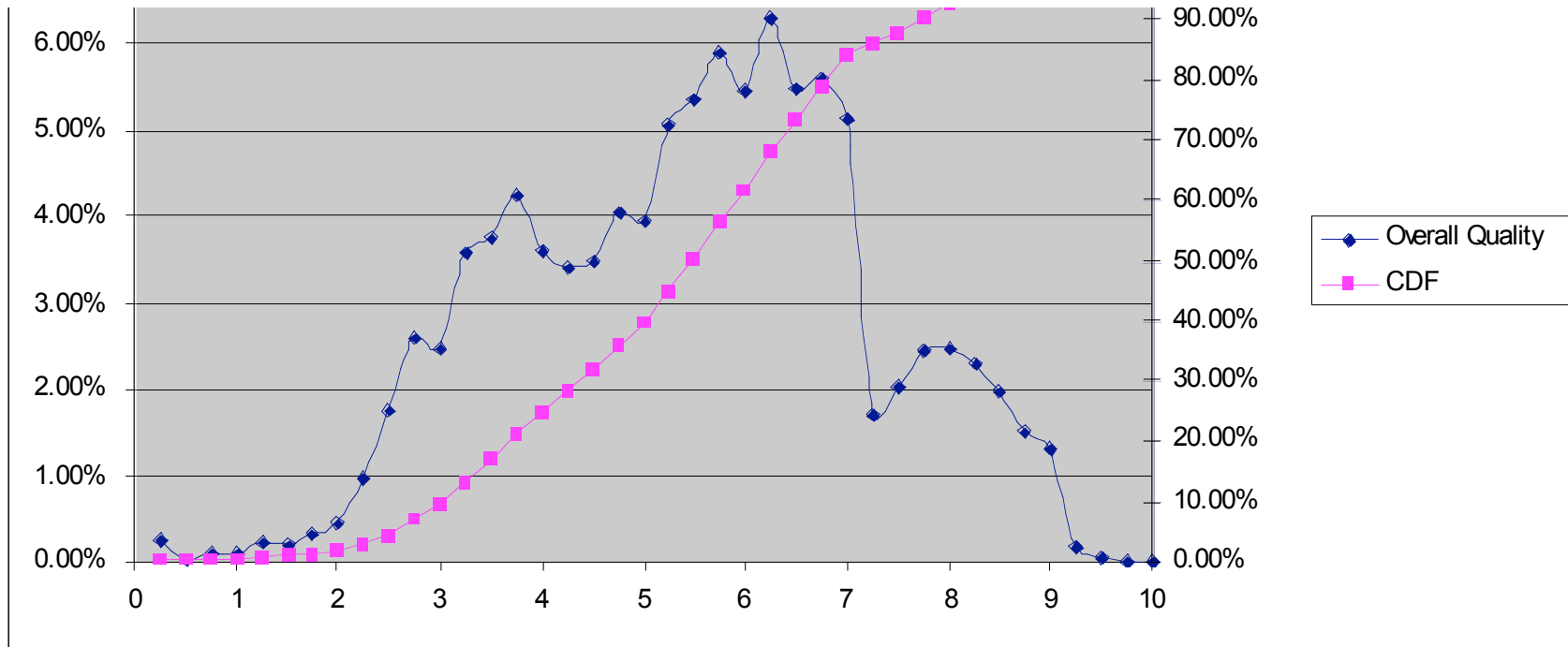


Face Data Quality Issues

- Cluttered background
- Legacy data – e.g. scans of 10+ year-old Polaroids
- Non-frontal pose
- Inconsistent lighting
- Multiple heads
- Low resolution

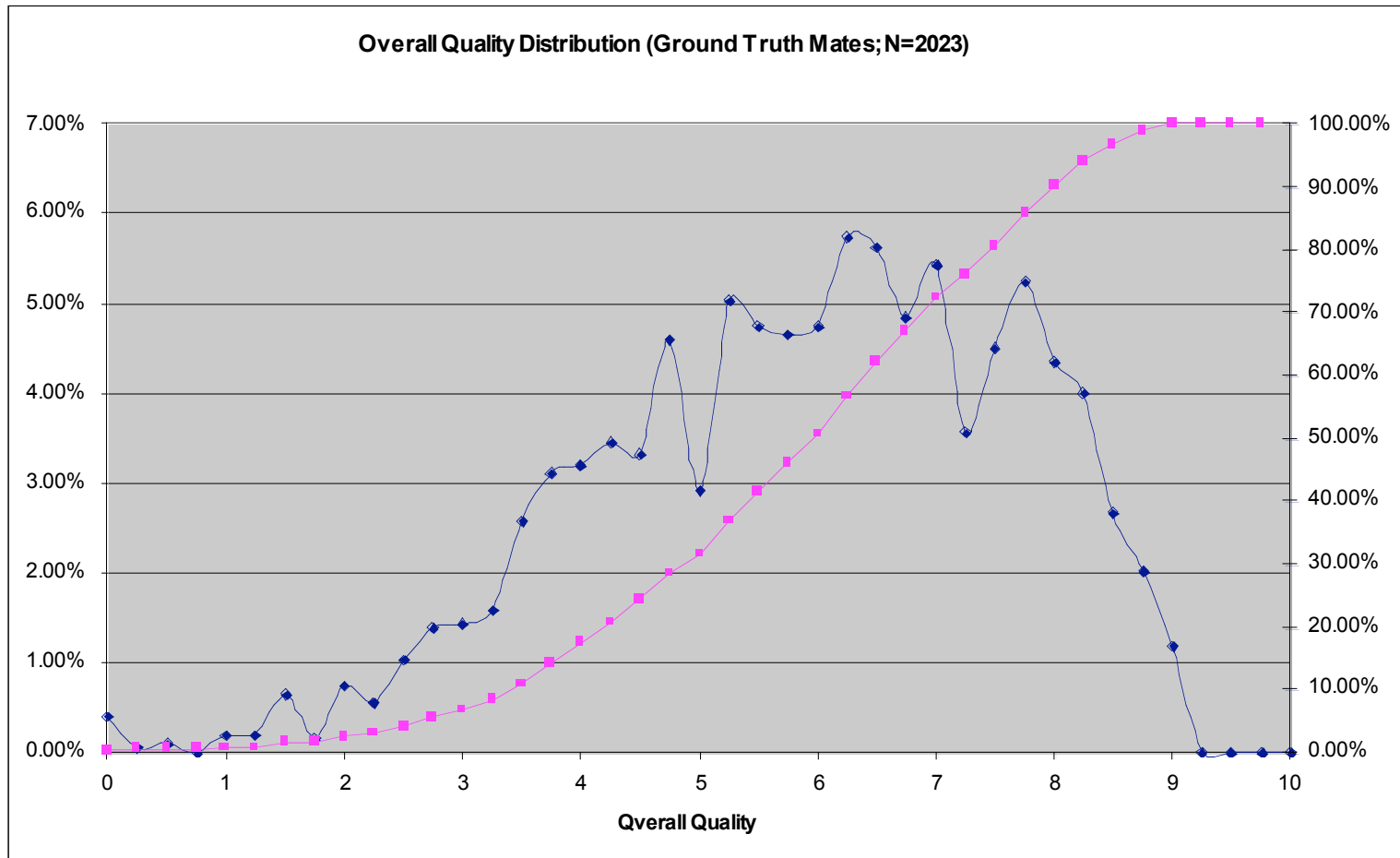


Face Quality Findings I





Face Quality Findings II

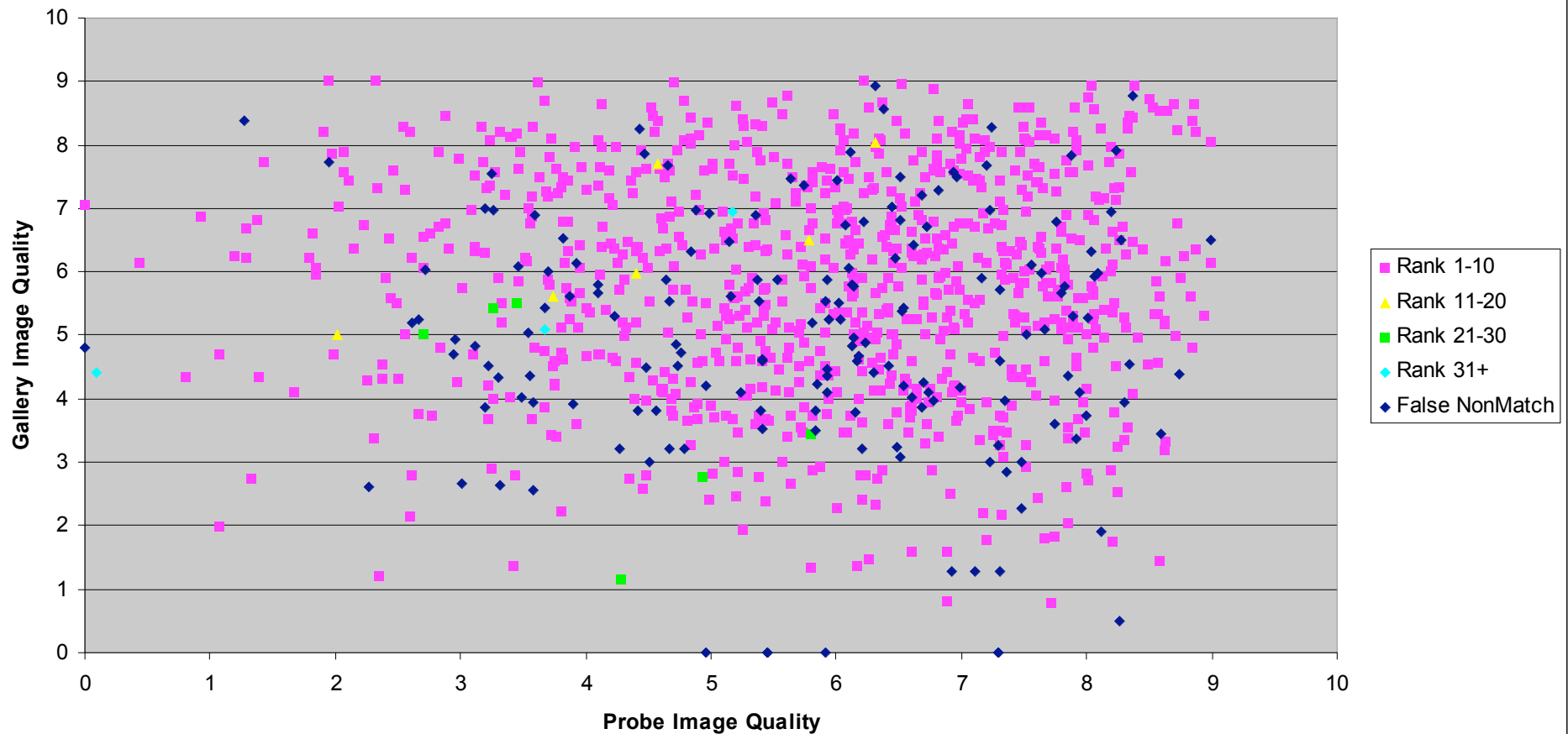




Face Identification Performance and Quality



Match/False Non-Match vs. Overall Image Quality (1039 mated pairs)





Iris



- Evaluation methods
- Quality findings



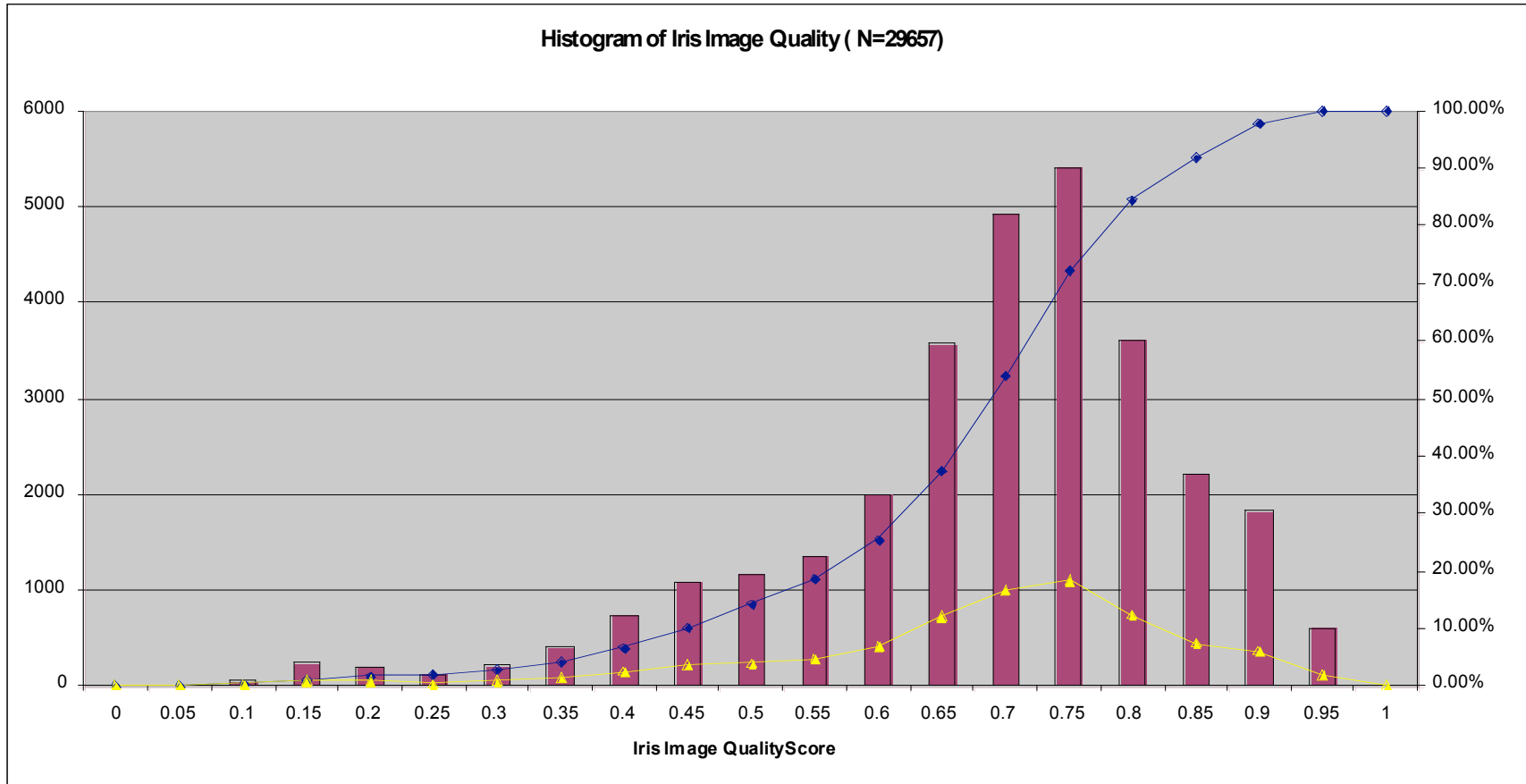
Iris Image Quality Evaluation



- Method of Kalka and Schmid from WVU
- 7 dimensions
 - Occlusion, motion blur, defocus blur, lighting, pixel counts, specular reflection and off-angle
 - Overall quality computed by applying Dempster-Shafer method using Murphy's rule to normalized (0.0-1.0) dimensions

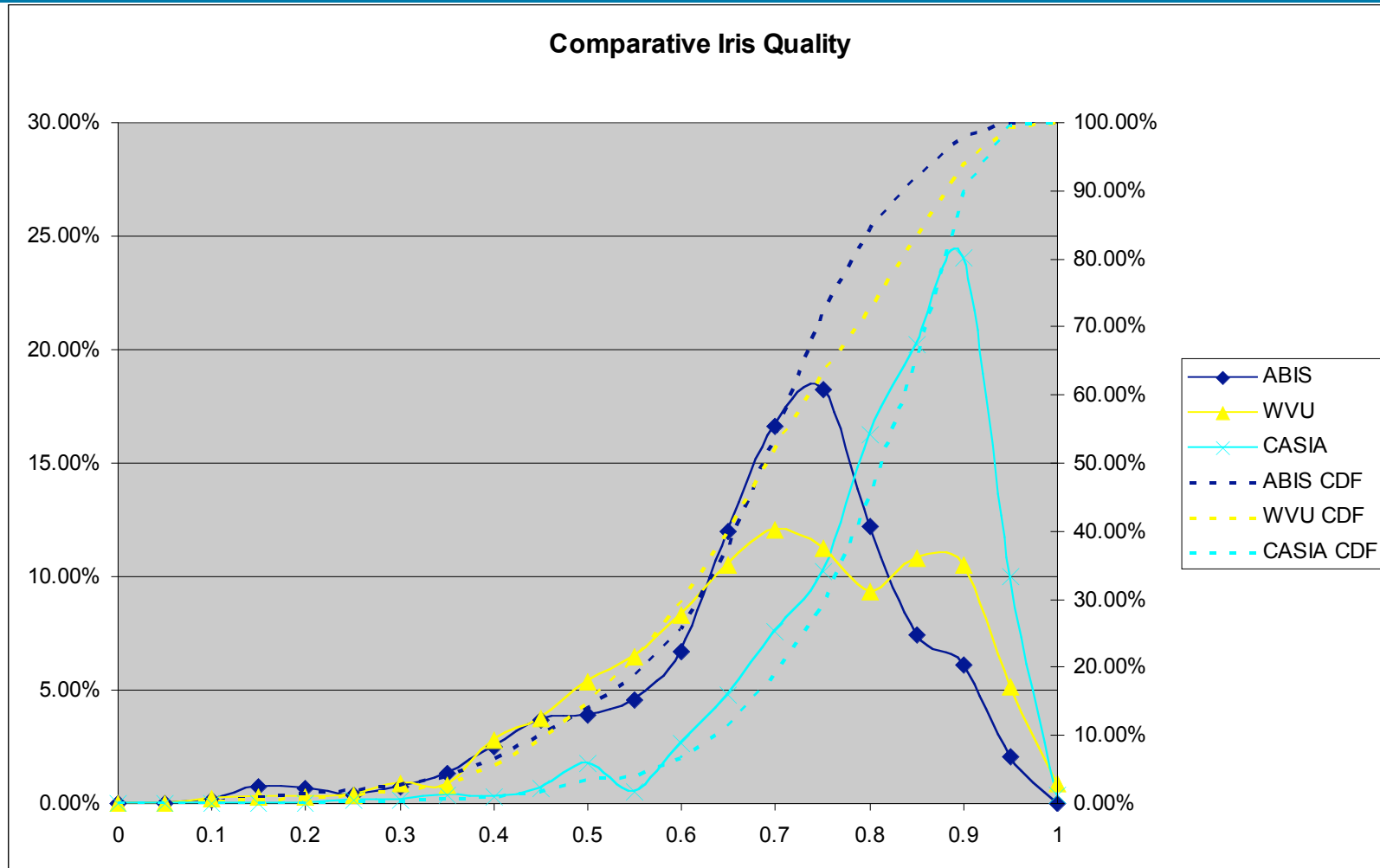


Iris Quality Findings I





Relative Iris Quality



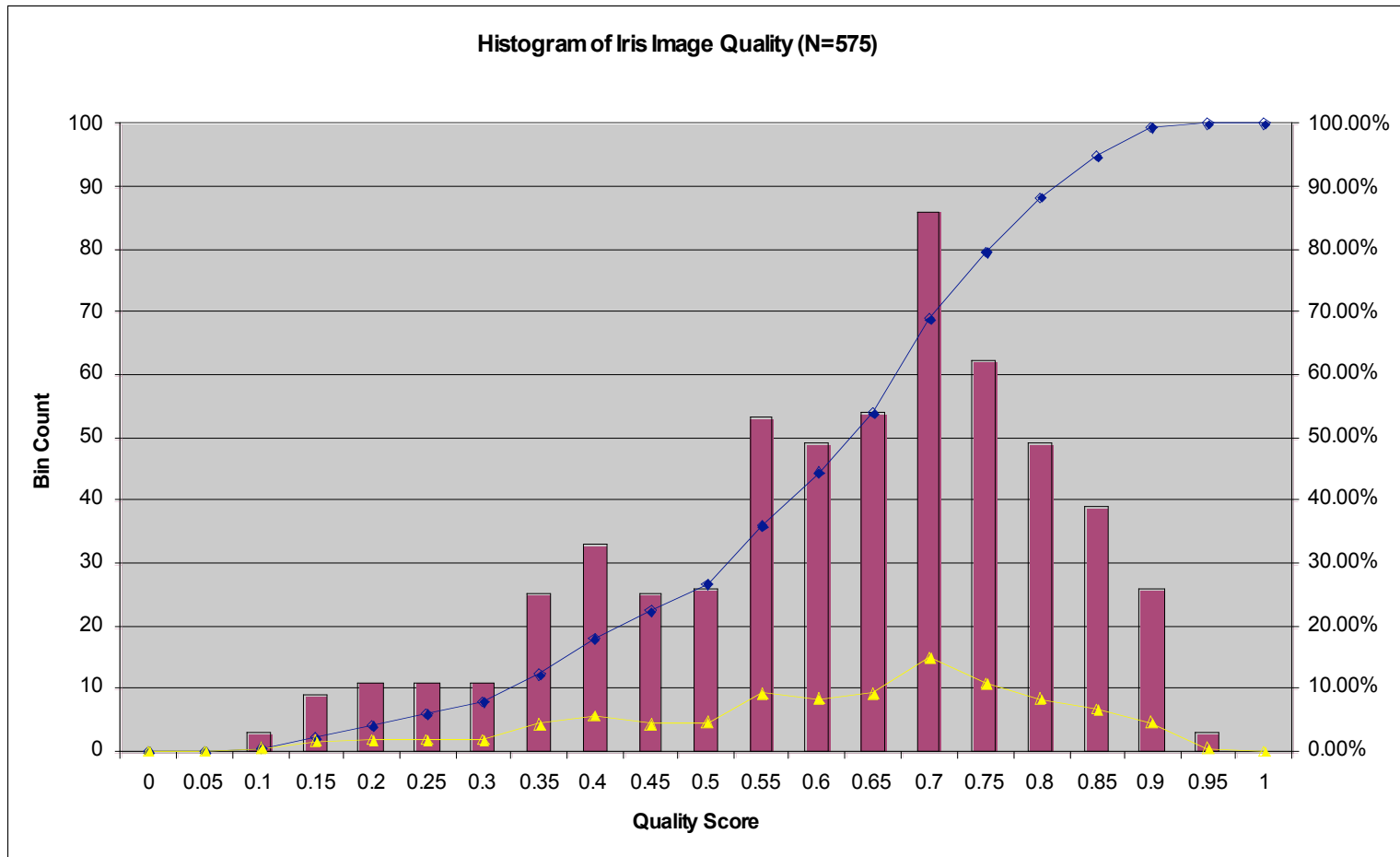
WVU and CASIA Iris Quality Scores courtesy of Nate Kalka, WVU

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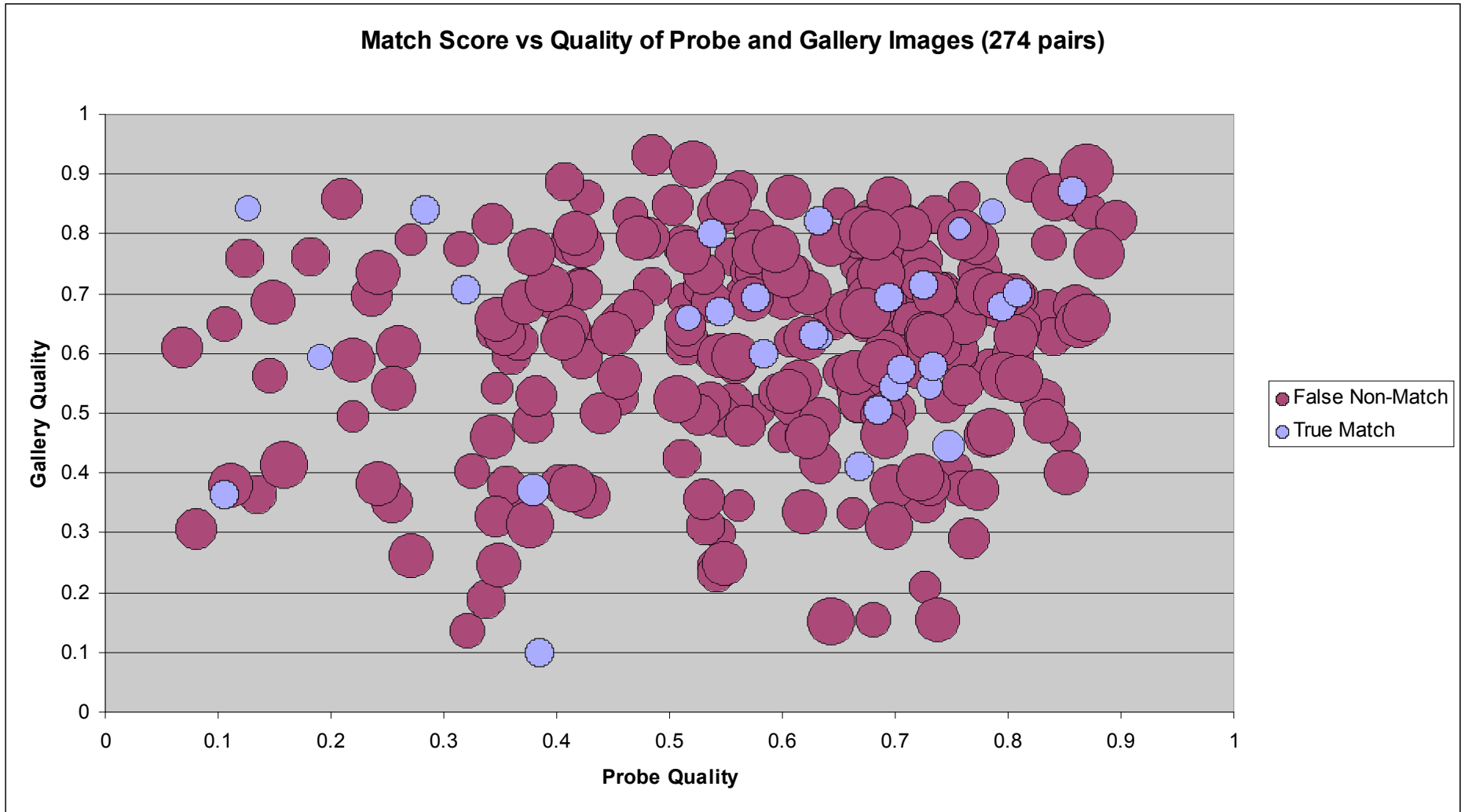


Iris Quality Findings II





Iris Identification Performance and Quality





Challenges

- Need real-time feedback at point of collection
- Need either
 - generic, algorithm-agnostic quality metrics
 - or, algorithm (vendor)-specific quality metrics
- Want performance-predictive metrics
- Machine perception and/or human perception?
- Need to understand tradeoff involving very low quality data
 - can we quantify diminishing returns?
 - can we justify excluding some samples?



Collaboration Opportunity

- We have plenty of real-world data.
 - Unfortunately, not for public dissemination
- However, we welcome the chance to evaluate new ideas using our data set for mutual benefit.
 - WVU – iris image quality assessment
 - BAH – finger image quality assessment
- POC:

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Questions?



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