Biometric Sample Quality Standards

Importance, Status, and Direction

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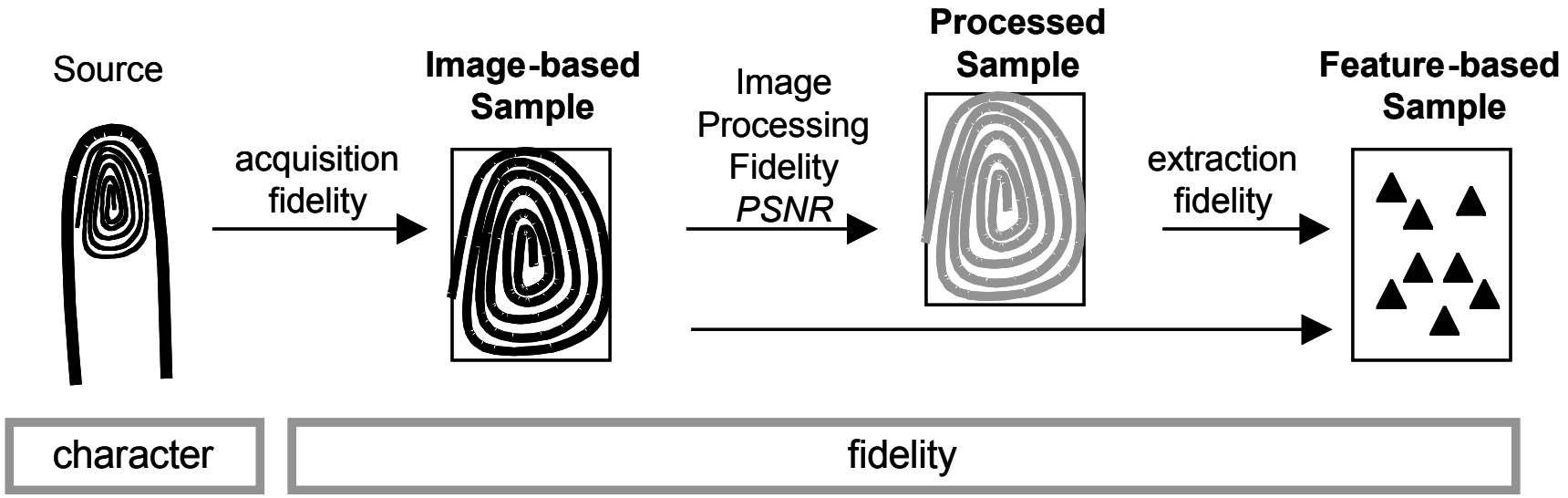
ISO/IEC SC 37 Project Editor – Biometric Sample Quality Standard - Part 1 (29794-1)

The Importance of Biometric Sample Quality Scoring

- It is useful upon capture of a biometric sample to be able to predict its future behavior in a matching environment
  - What are the probabilities of a false accept and a false match?
- In this way, samples likely to lead to poor matching performance may be screened upon capture, and subsequently recaptured
- Matching performance is improved by keeping poor quality samples out of the matching environment

Several Contributors/Detractors to Quality



- It would be useful to differentiate between different sources of quality problems
  - Ascertain whether a recapture attempt is useful
  - Troubleshoot quality problems

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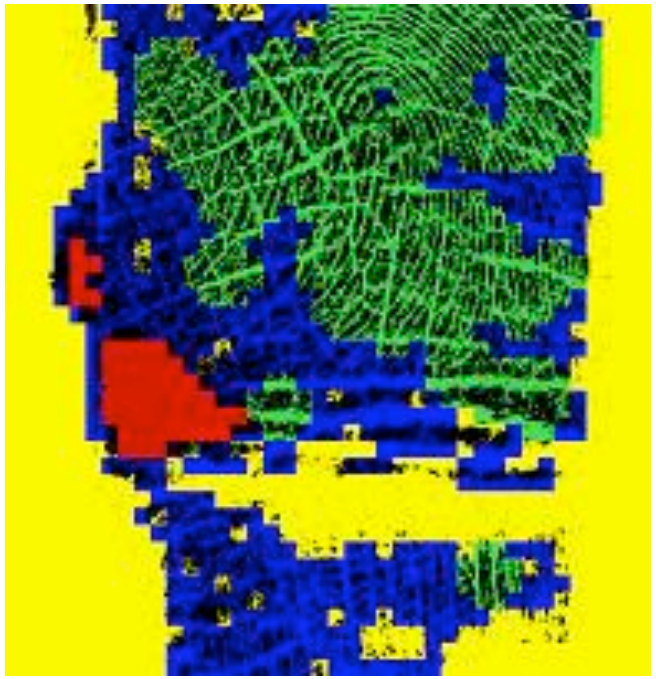
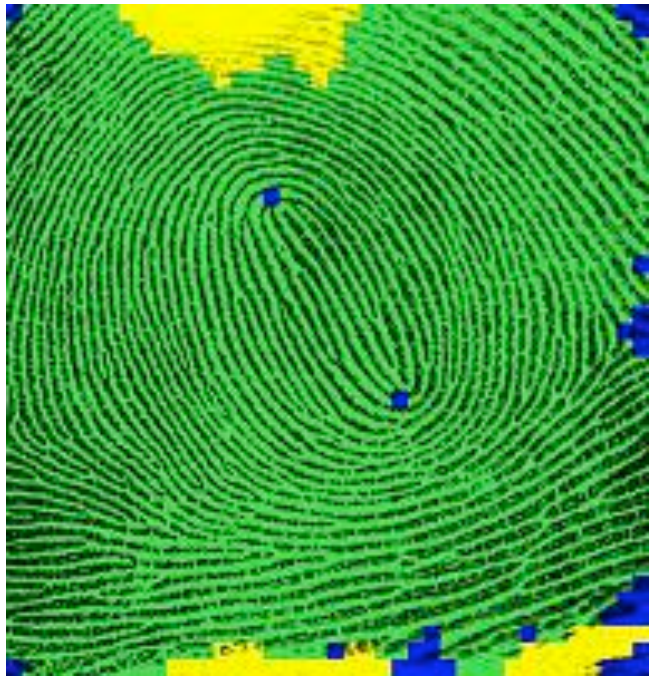
Fingerprint Image Scoring Example



Score = 14/100



Score = 81/100

- good quality
- Poor ridge flow or poor minutiae
- too dark
- too light

The Heart of the Standardization Challenge

- **Sample quality is largely subjective**
- Quality algorithms are better aligned with some matchers than others
- A quality algorithm may attempt to be predictive of many matching algorithms, or be optimized to align with a specific matching algorithm
- Different applications and markets have different matching, quality and cost/performance requirements
  - Identification vs. verification
  - Flats vs. rolls
  - High/low resolution
- Technology is evolving
- So…we are inclined to explore standardization mechanisms that enable an open, competitive marketplace for quality algorithms

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Standards Background

- M1 and ISO/IEC biometric data interchange format standards already provide a Quality Score field, but do not define its use
  - When I get a score, I don't know what it means
- BioAPI defines a 0-100 quality score range and bins
  - 0-25: unacceptable
  - 26-50: marginal
  - 51-75: acceptable
  - 76-100: excellent
- The value of a meaningful, interpretable score was conveyed to the standards body

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Standardization Approach

- Quality scores should aim to be predictive of sample behavior in a matching environment
- Quality scores must be interchangeable between disparate systems
  - Transportable via biometric data interchange formats
- Quality scores must be meaningful, interpretable and useful
- Standard should define common terms, reference model, and other relevant factors
- Standard should harmonize concepts and fields between modalities
- Standard should provide best practice guidance
- Standards should foster competition and future performance improvements
- Algorithm performance assessment on the drawing board

What DIF Quality Standards are Not

- Not intended to set minimum levels of quality required for a given application
- Not intended to set minimum quality algorithm performance requirements
- A quality score and the term “quality” are not used to describe the acquisition settings of the sample, such as image resolution, dimensions in pixels, grayscale/color bit depth, or number of features

A Spectrum of Approaches

(roughly in order of degree of prescription)

- Quality Algorithm Identification (QAID)
- Normalization techniques
  - Linear scaling
  - Percentile rank
- Impairment notification
  - Features
  - Fidelity value (eg. PSNR for compression)
- Specification of datasets and associated target scores (QSND)
  - Essentially a quality algorithm performance test tool
- Algorithm classification and certification
- Scoring algorithm standardization

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Quality Algorithm ID

- The Quality Algorithm ID (QAID) is an identifier of the quality algorithm used to assign the quality score of the sample
  - Quality algorithm vendor
  - Quality algorithm product code
  - Quality algorithm version major/minor
- QAID fields can be added to data interchange formats to complement the Quality Score field
- The existing IBIA Format Owner Registry provides a list of two-byte codes for vendors, which will be used to indicate the vendor of the quality algorithm used to score the sample in the INCITS-compliant data file
- ANSI NIST Type 10 record being updated to support QAID

QAID Pros and Cons

- Pros
  - Relatively easy to implement the standard
  - Applicable across modalities
  - Enables file recipient to properly interpret score
  - Enables multi-vendor environment
  - Enables use of new, improved algorithms
- Cons
  - Does not attempt to define what is good/bad quality
  - Requires file recipient to perform some interpretation of scores, at least initially

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Usefulness of QAID

- Accommodate use of different quality algorithms in a system
  - Differentiate samples scored by different algorithms
  - Vary thresholds according to algorithm ID
  - Enable modular systems, multi-vendor marketplace
- Quality-based conditional processing
  - Apply different matching techniques for different quality score ranges
- Analysis of relevant statistics
  - Collect and store quality data that can be used to assess correlation to various conditions, such as operator, scanner, matching algorithm, time of day, etc.
- Enables flexible use and development of technology

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Other Optional Techniques Supported

- Image processing fidelity
  - Indicates amount of distortion introduced to image by compression or other process
- Algorithm classification
  - Anticipates future standards activity by which quality algorithms may be certified
- Impairment bitfield
  - Indicates defects in a sample, such as non-compliant features in a facial image

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Standards Status – M1

- Biometric Sample Quality Standard in progress at M1.3 group (data interchange formats) since 2004
- Revision 5 (M1/06-0181) headed to ballot to be considered for release for public comment
- M1 standard will be used to convey Quality Algorithm ID (QAID) in data interchange formats
- Standard is proposed for adoption by data interchange format standards for each modality as they amend, revise, and update their respective standards/drafts
- Content of M1 standard has been submitted as suggested content to ISO/IEC work

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Standards Status - International

- The November 2004 in Paris resulted in the establishment (N0923) of Quality Rapporteur Group
- The Quality Rapporteur Group met and produced a Report (N1128), which was presented in South Africa in July 2005
- The Report made several recommendations and suggestions
  - Quality score purpose, expression, and definition
  - CBEFF
  - Scoring methods
- A project was approved to develop a multipart biometric sample quality standard (ISO/IEC 29794-1/4/5)
- Working drafts have been posted for comment and review at July 2006 SC 37 meeting in London

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Some Relevant Documents

- M1/05-0091: M1 submission to SC 37 describing QAID
- M1/06-0181: Biometric Sample Quality Standard Draft 5

- N1128: QRG Report
- N1211: WG3 NP
- N1477: 29794-1 WD1
- N1503: 29794-4 WD1

Thank you!

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