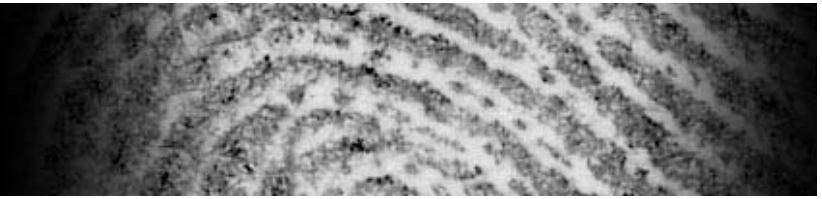
CDEFFS

ANSI/NIST Committee to Define an Extended Fingerprint Feature Set



Standardizing a More Complete Set of Fingerprint Features

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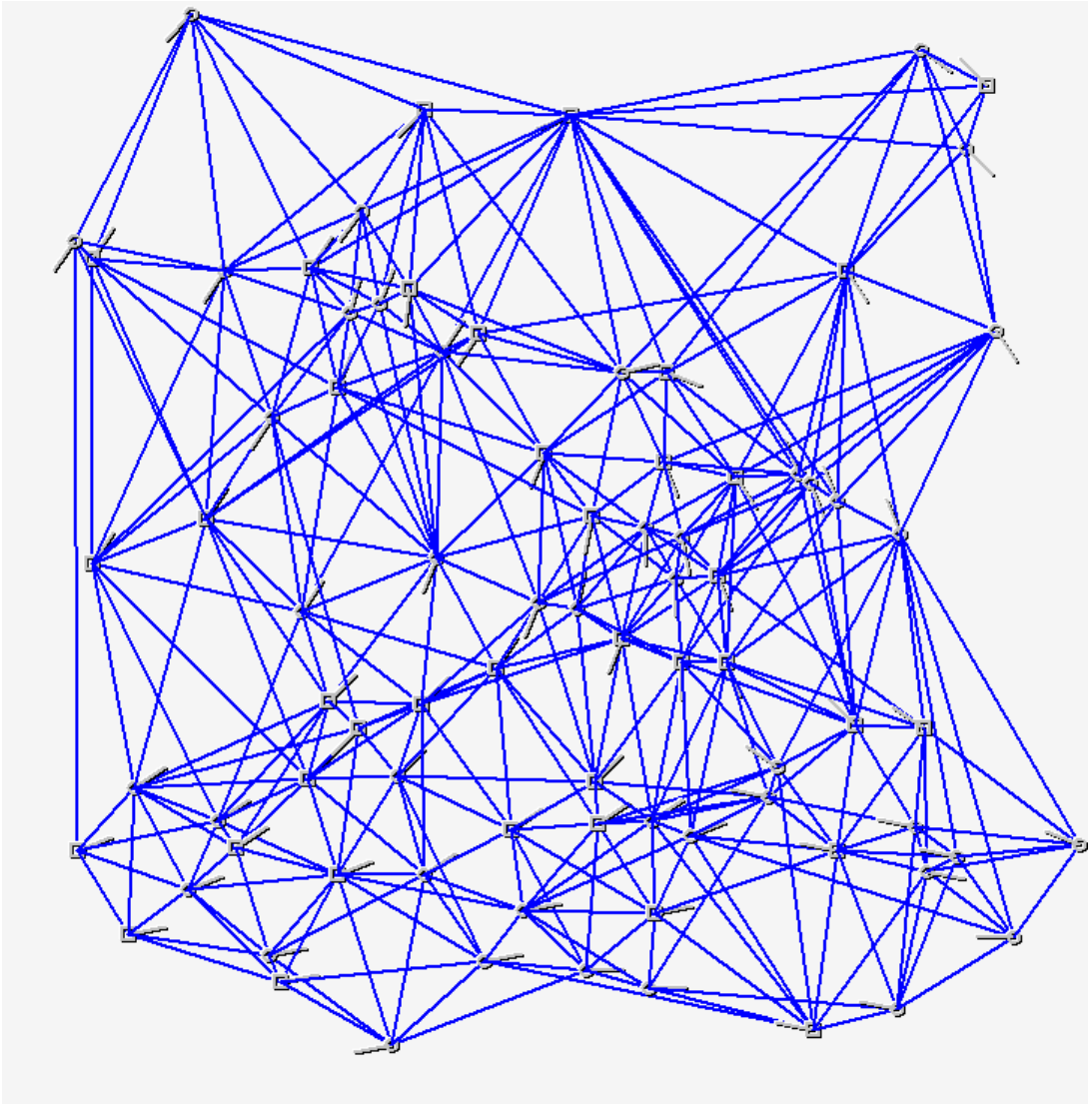
noblis

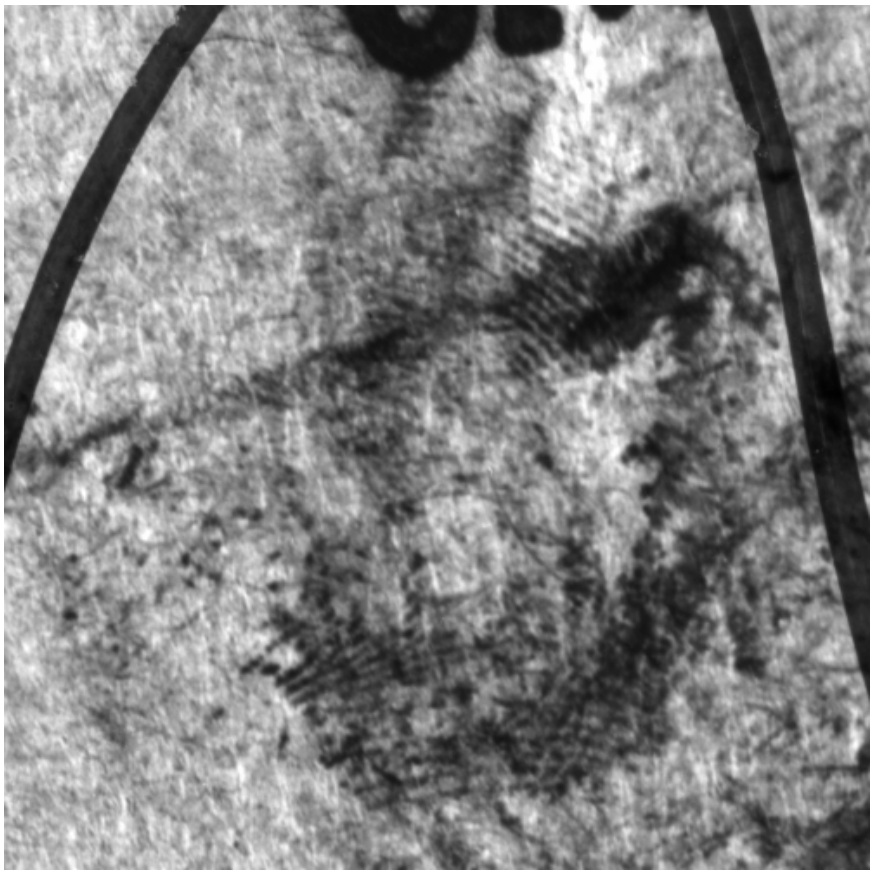
For the best of reasons

Problem #1: AFIS Searches



- AFIS searches are limited by oversimplified feature sets

Problem #2: Latent Examiner Comparisons



- There aren’t standard formats to document the features used in comparison decisions, for future reference or interchange with other examiners.

CDEFFS

- Fall 2005: SWGFAST drafted a memo to NIST, noting the features used by expert human latent examiners that are not currently addressed in fingerprint feature standards.
- Dec. 2005: The ANSI/NIST Standard Workshop II chartered the Committee to Define an Extended Fingerprint Feature Set (CDEFFS).
- CDEFFS includes 45 members from various Federal agencies, the latent community, AFIS vendors, and academia.

Working Draft Standard

- “Data Format for the Interchange of Extended Fingerprint and Palmprint Features”, Working Draft 0.1, March 2007
- Addendum to ANSI/NIST-ITL 1-2007, defines a new Type-18 record type
- Available at
  - fingerprint.nist.gov/standard/cdeffs
  - Google “CDEFFS”

Purpose

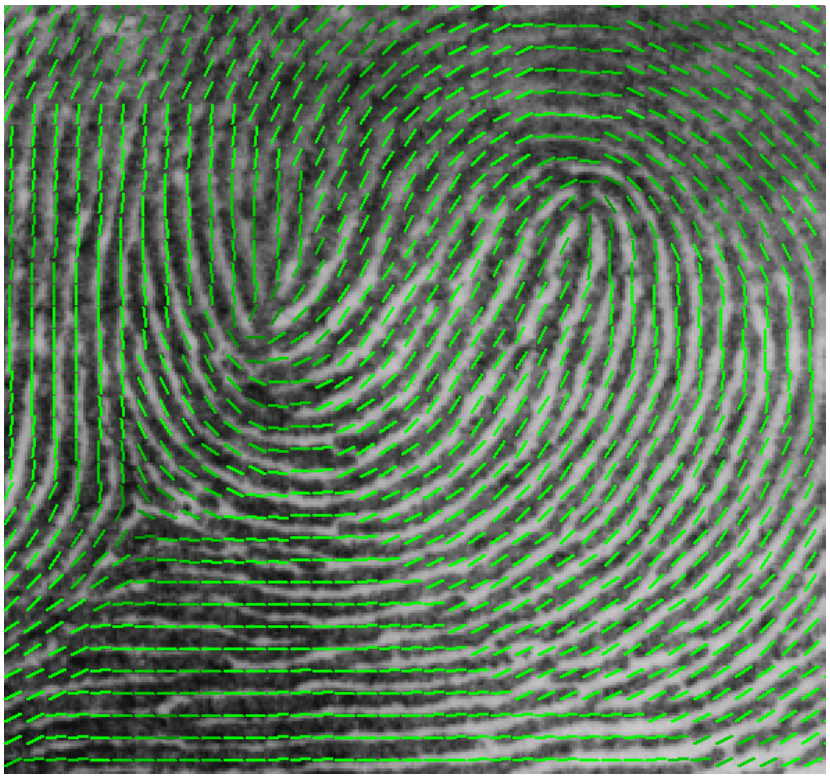
- To have a standard that more completely represents the distinctive information in the fingerprint
  1. For human examiner-initiated latent (or poor-quality) fingerprint searches of automated systems
  2. For human examiner markup and exchange of latent (or poor-quality) fingerprints

Potential Benefits

- Indicating areas of improvement for automated feature extraction and matching algorithms
- Interoperability of fingerprint feature definitions (or a universal feature set)
- Improved basis for modeling
  - The uniqueness of fingerprints
  - The information content of fingerprint features
- Basis for special-purpose latent end-stage matcher
  - A matcher that would require human markup of both fingerprints being compared, but would quantify similarity

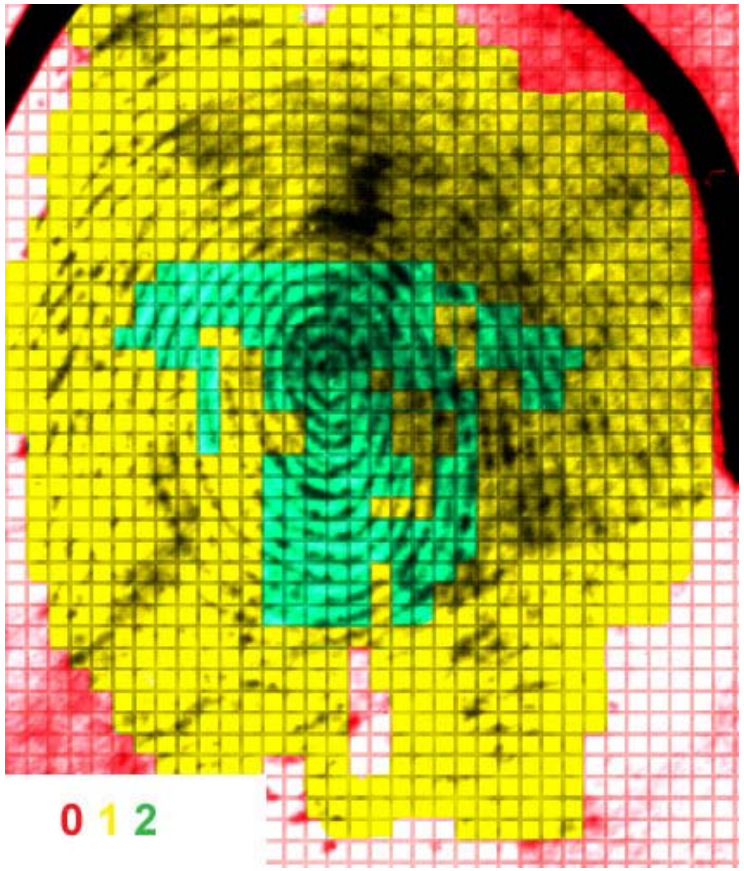
Features

Ridge flow map



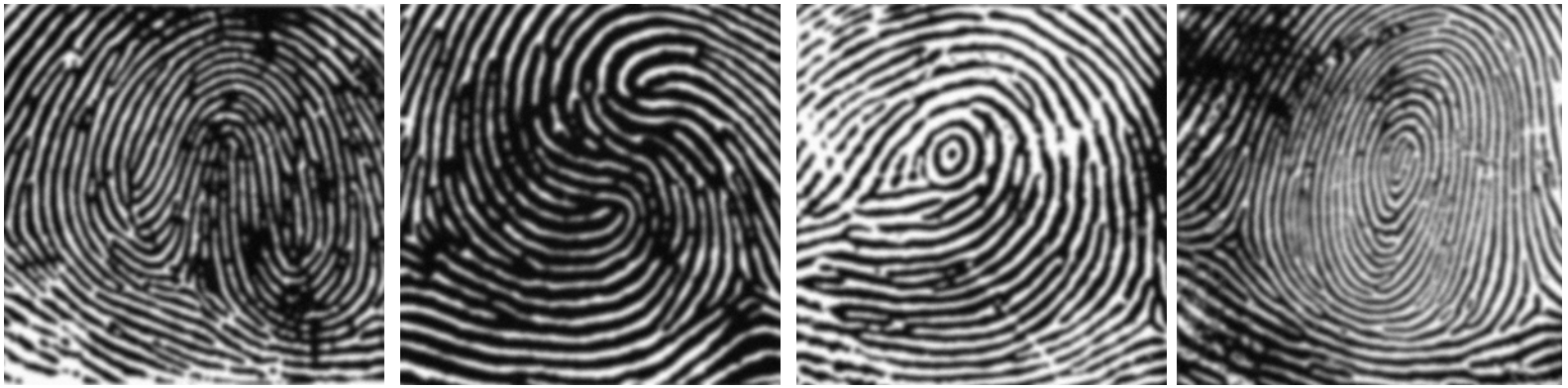
- Ridge flow maps serve many of the purposes of pattern classification, but are effective for partial fingerprints

Local Ridge Quality



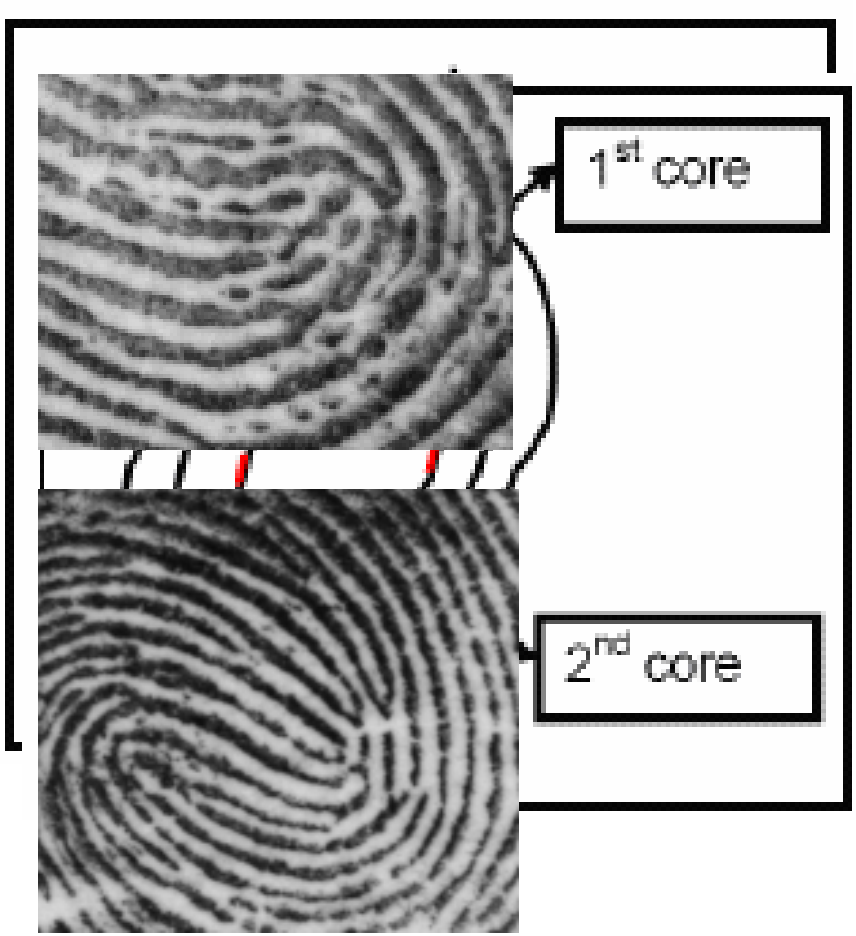
- 4-level quality value for each square in a grid:
  - 0: No usable ridges or fingerprint features
  - 1: Poor quality ridges present, but presence/absence/location of minutiae is not definitive
  - 2: Presence/absence/location of minutiae is definitive
  - 3: Ridge width and edge shape are clearly discernable

Pattern Classification



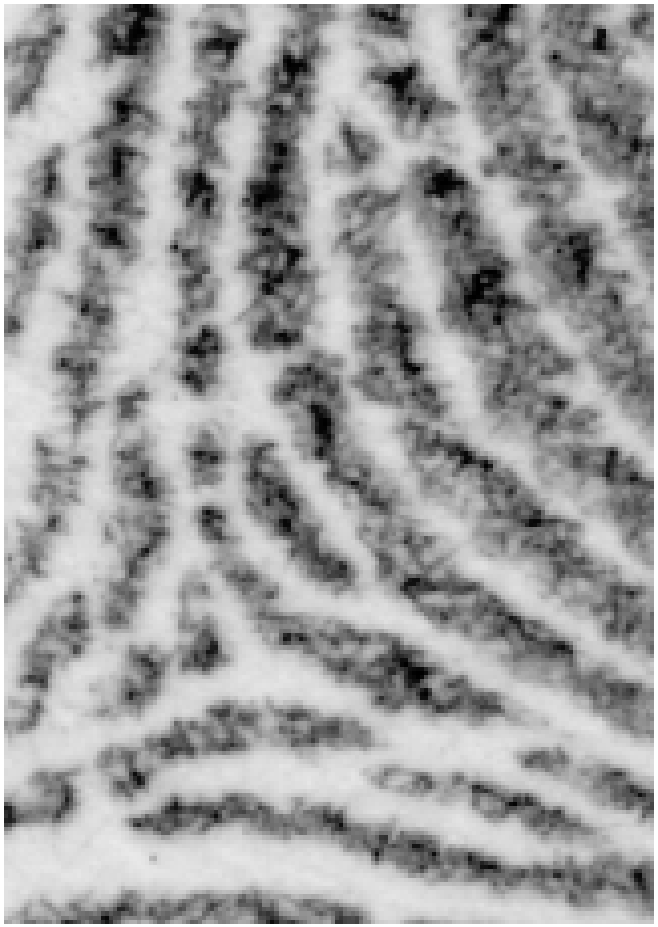
- CDEFFS will include fields for NCIC-style pattern classification
  - including accidental whorls, central pocket loop, tented arch, etc.
  - Inner/outer/meeting for whorls
  - Core-delta ridge counts are included as a separate field

Cores



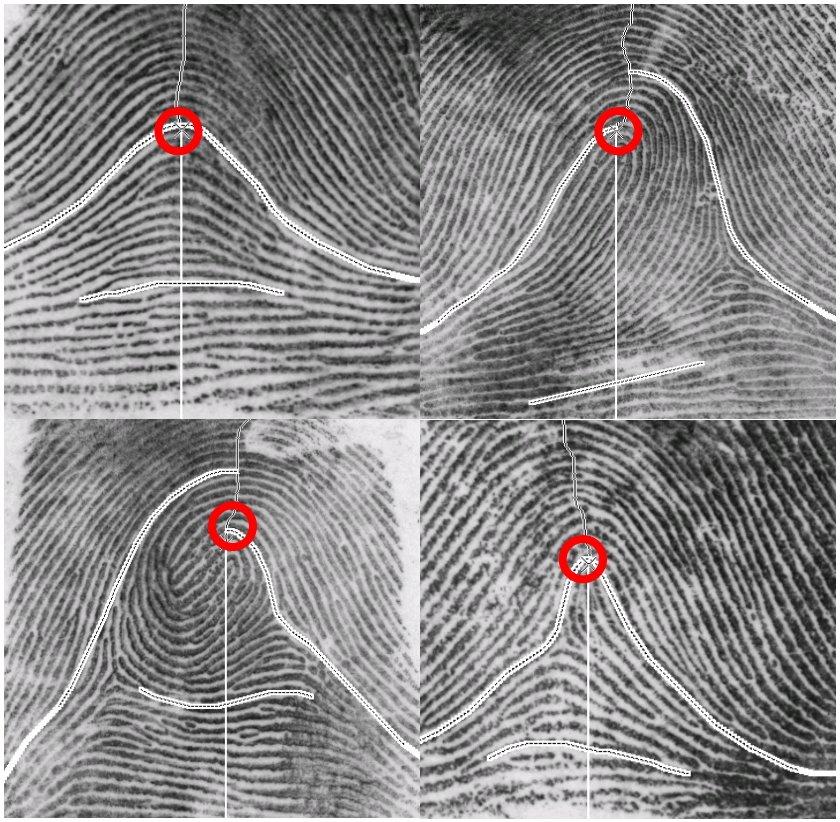
- The “Science of fingerprints” locations for cores are difficult for consistent automated detection
- There is general concurrence on placing the core at the focus of the innermost recurving ridge (not on the ridge itself)

Deltas



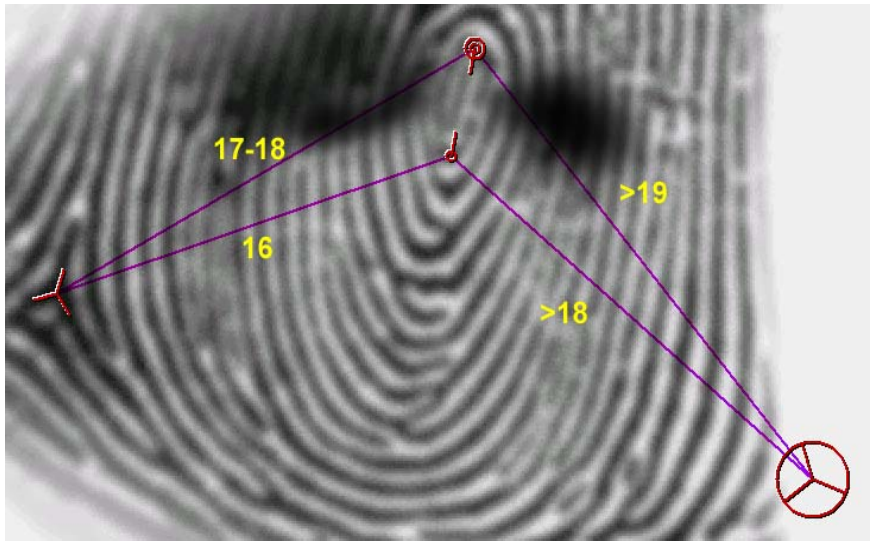
- The position and directions of CDEFFS deltas are defined just as in EFTS.
- Deltas should be marked whenever a delta structure is present (i.e. for tented arches, or in cores).

Center point of reference



- **A common center point of reference is of value for several purposes, such as**
  - **Overall quality assessment (clear ridge detail is present for N radius around center)**
  - **Exclusions (easier if both prints include area around center)**

Core-Delta Ridge Counts

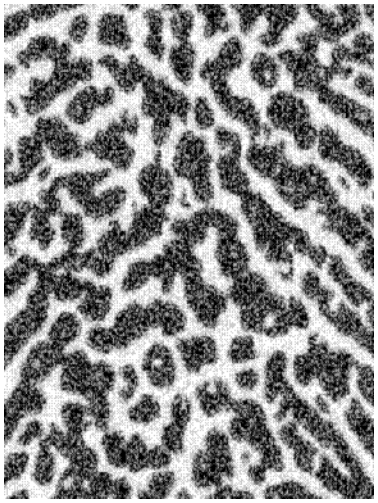


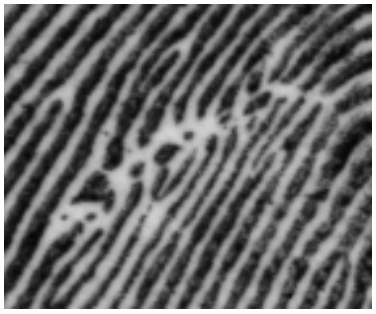
- Ridge counts between all cores and all deltas
- Allow for
  - Exact count
  - Range
  - Minimum count

Ridge Path

- Use a tracing/skeletonized image as a representation
- Note that the tracing does NOT replace the image: it is just a clear way of communicating what is known about ridge interconnections
- Must be used in combination with Local Ridge Flow Quality

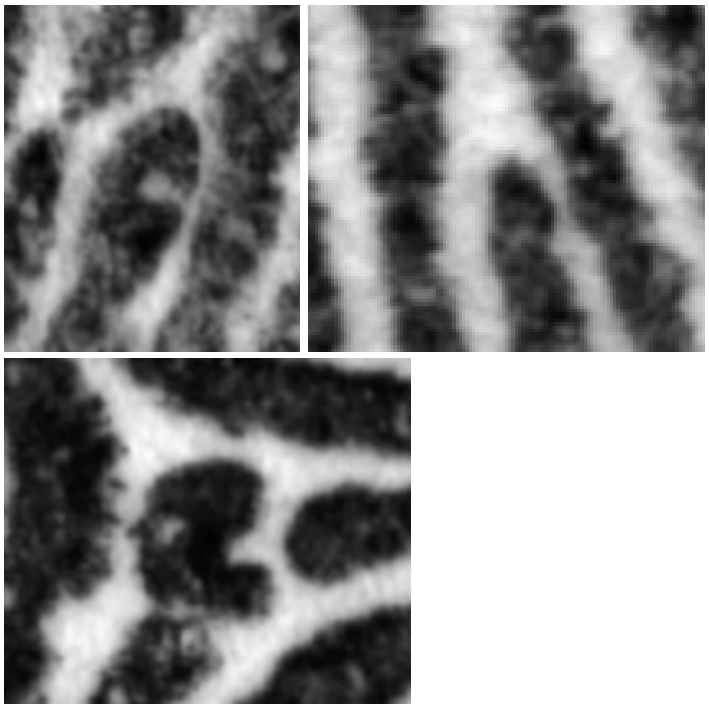
Distinctive Areas





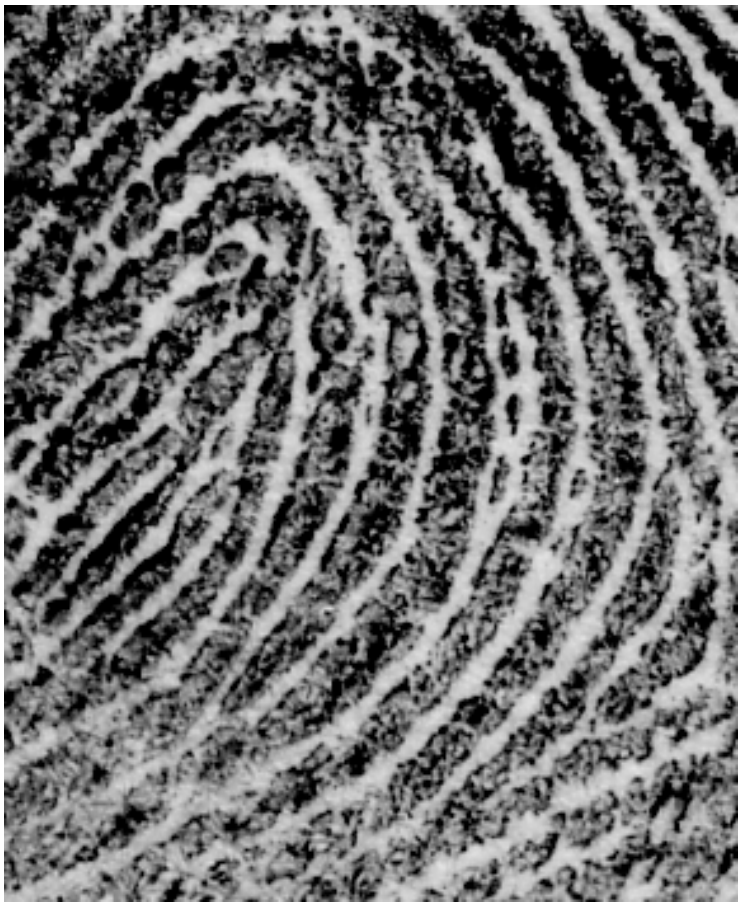
- A small area containing a composite of unusually discriminating /unique characteristics can be marked as a Distinctive Area.
- This is basically a way of flagging “Something unusual here that can’t be defined adequately using the other features”
- A matcher can respond to this in different ways, but may be used to identify areas for image-based or end-stage matching — which may use the image itself for matching.
- A Distinctive Area has a type:
  1. Core
  2. Delta
  3. Scar
  4. Dysplasia/Dissociated ridges
  5. Unusual minutia
  6. Overlap
  7. Other

Minutiae

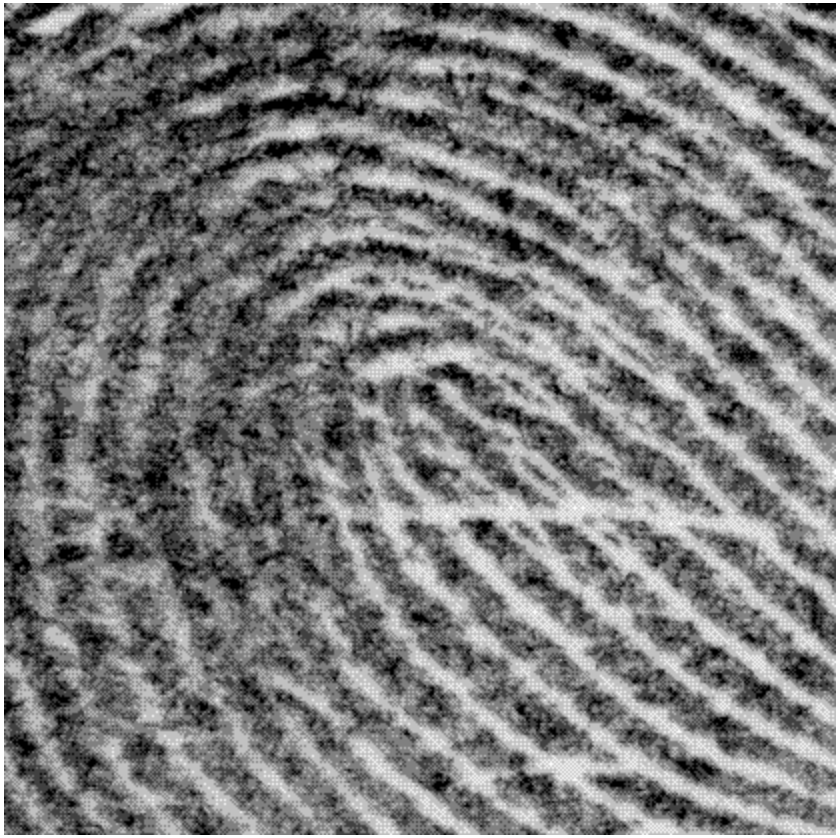


- Minutiae locations and theta are more precisely defined
  - Ridge endings are at the fork of the tracing of the valley
  - Bifurcations are at the fork of the tracing of the ridge
  - Theta is the midpoint of the two legs closest together, followed for 0.064” (32 pix@500ppi) or length of that leg
- Confidence
  - Confidence in existence (%)
  - Radius of position uncertainty
  - Direction uncertainty

Dots, short ridges, ridge protrusions, spurs, and incipient ridges



Dots, short ridges, ridge protrusions, spurs, and incipient ridges

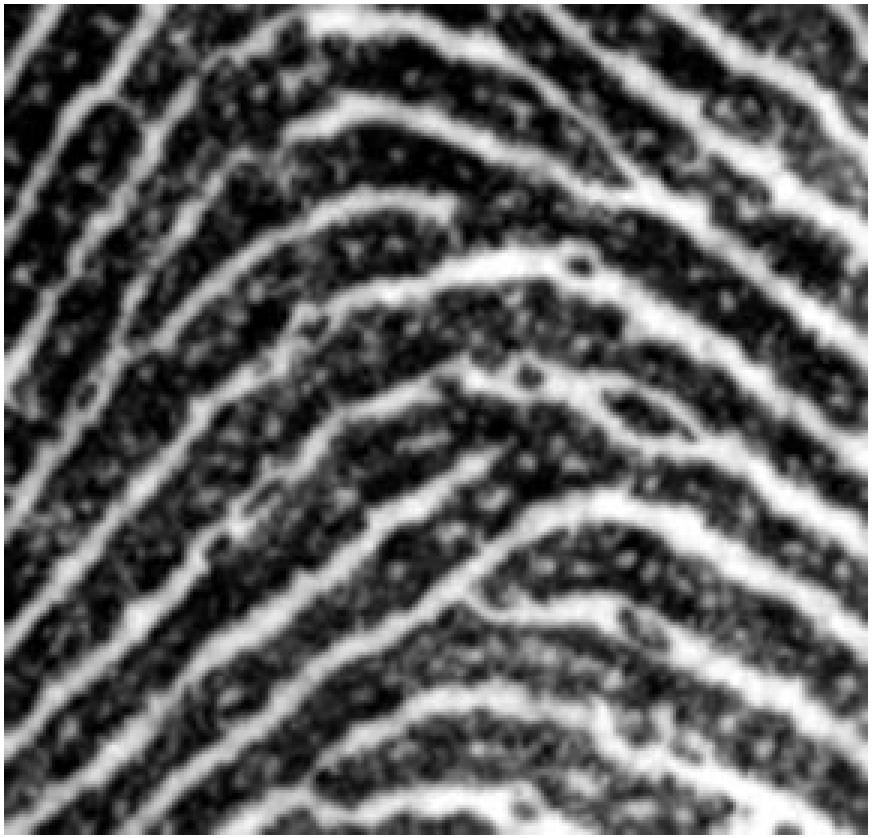


- All of these features are less consistent/reliable than minutiae, but can assist greatly in individualization
- For any of these features, matchers (and examiners) need to know that the feature may vanish or change type between prints

Dots, short ridges, ridge protrusions, spurs, and incipient ridges

- We handle as discrete features:
  - Dots
  - Incipient Ridges
  - Protrusions
  - Indentations
  - Discontinuities
  - Linear discontinuities
  - Permanent Flexion Creases

Dots

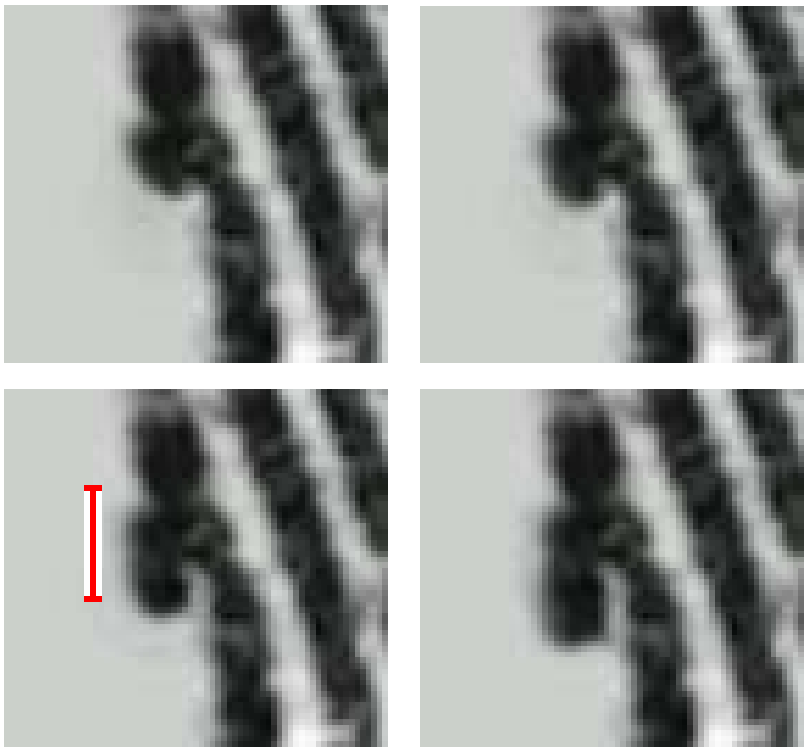


- A dot is a short ridge unit:
  - If longer than 0.02” it should be marked as a standard ridge, with a pair of ridge endings.
  - If substantially thinner than local ridge width, it should be marked as an incipient ridge

Incipient ridges

- An incipient is a thin ridge unit, substantially thinner than local ridge width.
- An incipient is marked with the X,Y endpoints along its longest dimension (a line segment).
- If the incipient is a series of clearly separate (thin) dots, they should be marked as separate incipients.

Protrusions



- A protrusion is an abrupt increase in ridge width that is not long enough to be called a bifurcation.
- An event is determined to be a protrusion using this logic:
  - An event on a ridge > 0.02” is a standard bifurcation/ending
  - <= 0.02” and an abrupt change in width is a protrusion
  - abrupt change: width increases by >50% in less than 0.01”
  - Otherwise leave unmarked

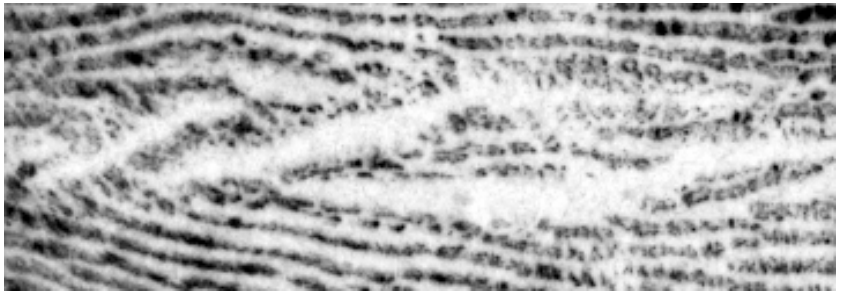
Indentations and Discontinuities

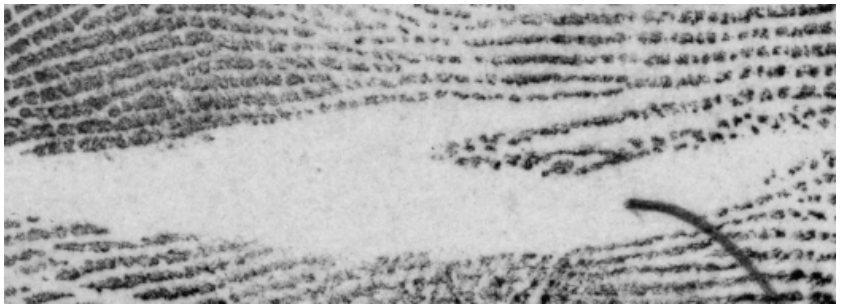
- An indentation is an abrupt decrease in ridge width.
  - An event is determined to be an indentation if the width decreases by >50% in less than 0.01”.
- A discontinuity is a point where the ridge stops briefly, and restarts again without shifting.
  - A discontinuity > 0.02”, or where the ridges do not line up across the divide, should be marked as two ridge endings.

Linear discontinuities

- Linear discontinuities are discontinuities that lie in a line, such as a crease, crack, cut, thin or non-permanent scar.

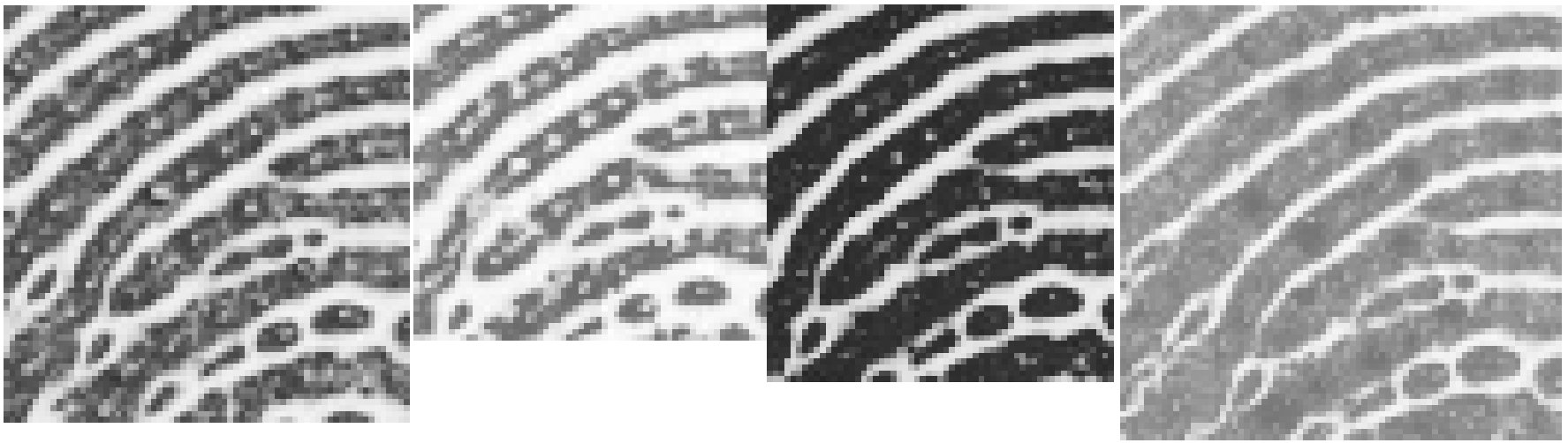
Permanent Flexion Creases





- The major flexion creases are the named creases that separate the joints of the fingers and divide the palm.
- These are marked as a series of line segments, along the center of the crease.
- For a feathered crease, multiple line segments may all share the same flexion crease label.
- Minor/secondary flexion creases (those that are not defined here) should be defined as linear discontinuities

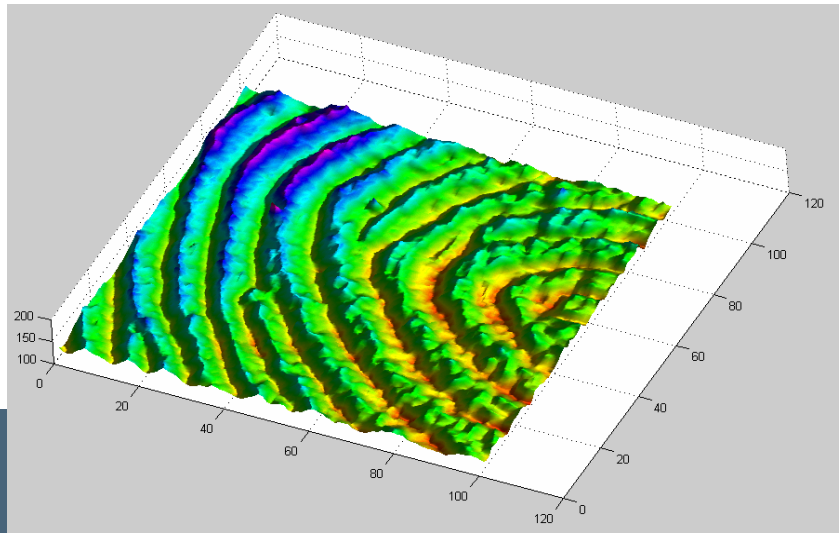
Pores



Taken by a UPEK 500-ppi solid state scanner

“Pores” & 3d data

- Some of what passes for pore data is actually non-pore variations in the ridge surface



Pores

Ink, 500 ppi

- The center of each pore is marked (x,y).
- Not-yet published FBI/LPU level-3 study indicates attributes size and shape are not reliable

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