Next Generation Livescan Technologies: Image Quality and Liveness Detection Data

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Fingerprint Standards, Law Enforcement, Homeland Security, and Economics

- Law Enforcement – The Beginning
- Authentication – The Other Biometrics
- Homeland Security – The Immediacy
- Economic Impacts – The Costs and Benefits

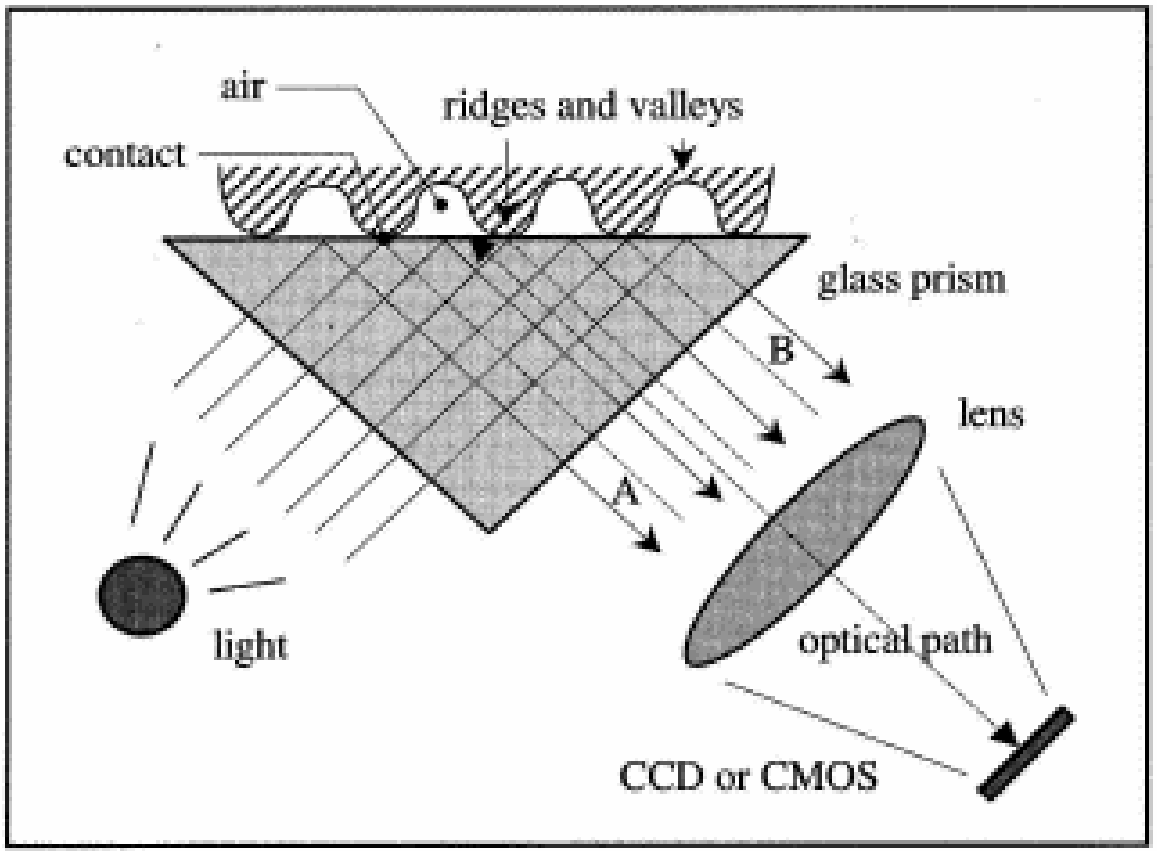
Converging Federal, State, Commercial Needs

- The First Electronic AFIS
- National IAFIS Rollout
- IDENT
- IDENT/IAFIS Integration Efforts
- USA Patriot Act
- US VISIT
- E-Authentication
- Trusted Traveler

Relation of ANSI/NIST and EFTS Standards

- EFTS a Provision of 1-2000: Appendix F and rest of EFTS part of ANSI/NIST by incorporation
- ANSI/NIST developed jointly by FBI and NIST
  - Fingerprint images transmitted to FBI must be ANSI/NIST compliant
  - Fingerprint scanner characteristics described by ANSI/NIST

Current Capture Technology: Frustrated Total Internal Reflection (FTIR)



Source: Sandström (2004)

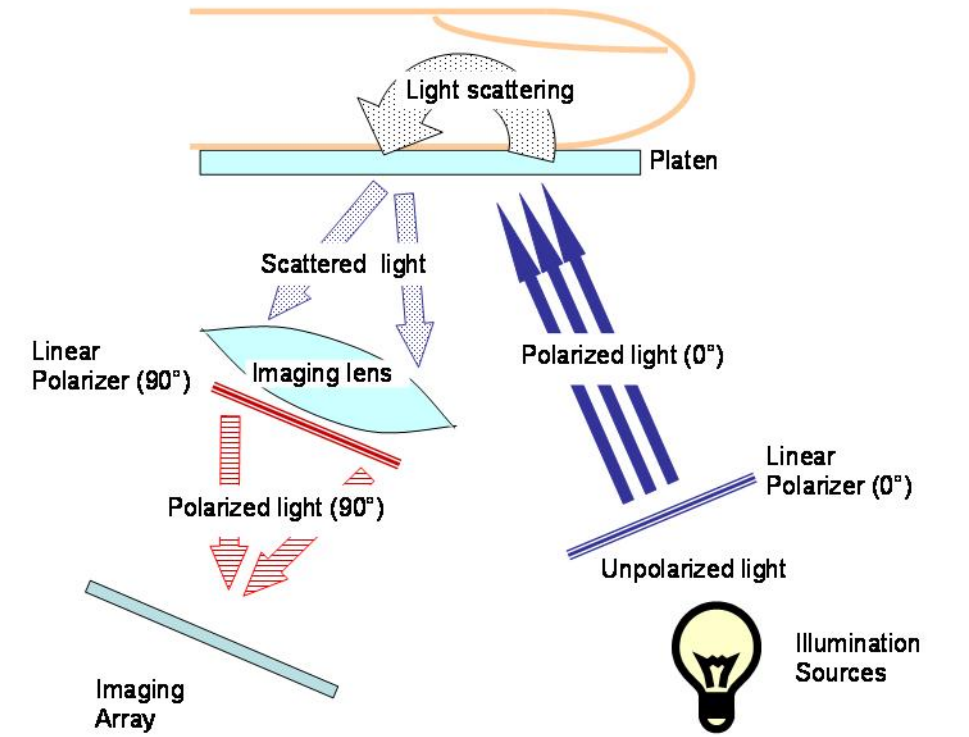
Fingerprint Image Quality and Scope Issues

- Ridge Patterns
- Minutiae
- Area Covered
- Level 3 Detail
- 3-D
- Subdermal characteristics

Next Generation Fingerprint Capture Technologies

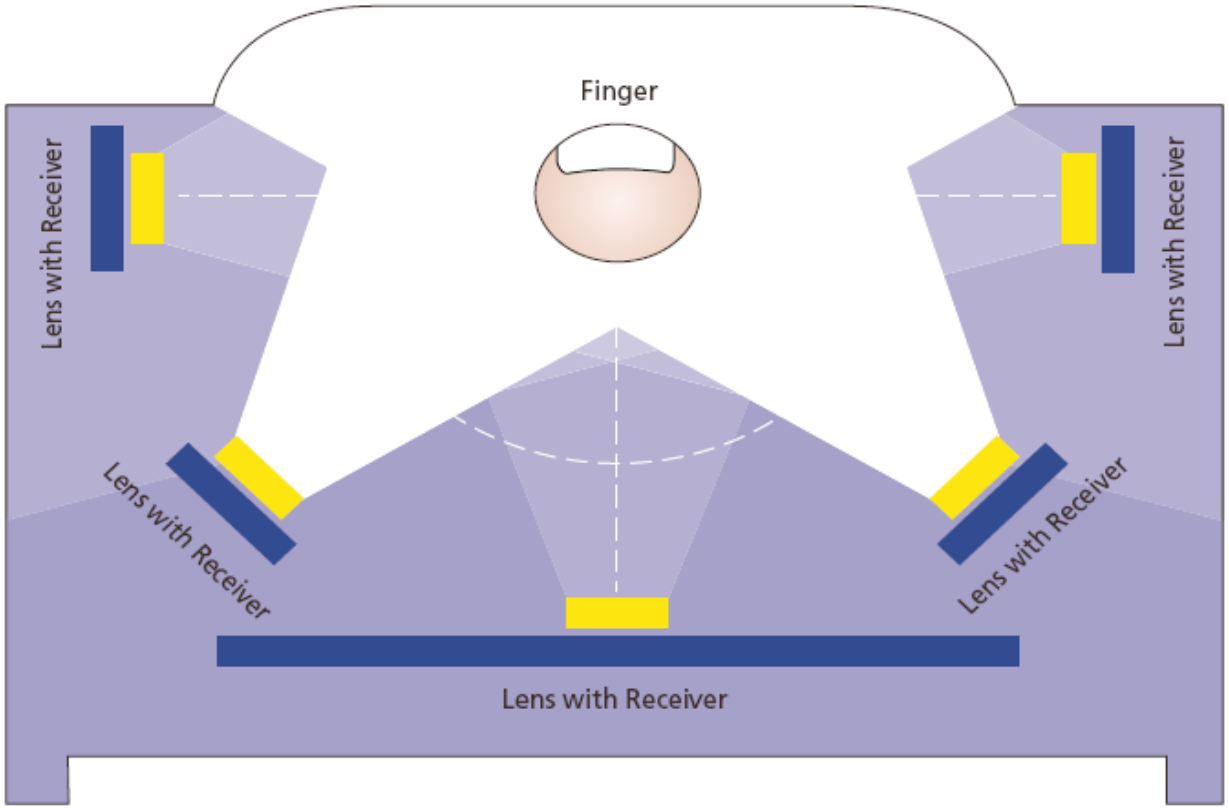
- Multispectral Imaging (MSI)
  - Lumidigm, Inc.
  - Production planned for 2005
  - www.lumidigm.com
- Touchless Optical Imaging (TOI)
  - TBS North America, Inc.
  - Production planned for 2005
  - www.tbsinc.com
- Ultrasound Imaging (USI)
  - Ultra-Scan Corporation
  - In production now
  - www.ultra-scan.com

Multispectral Technology from Lumidigm



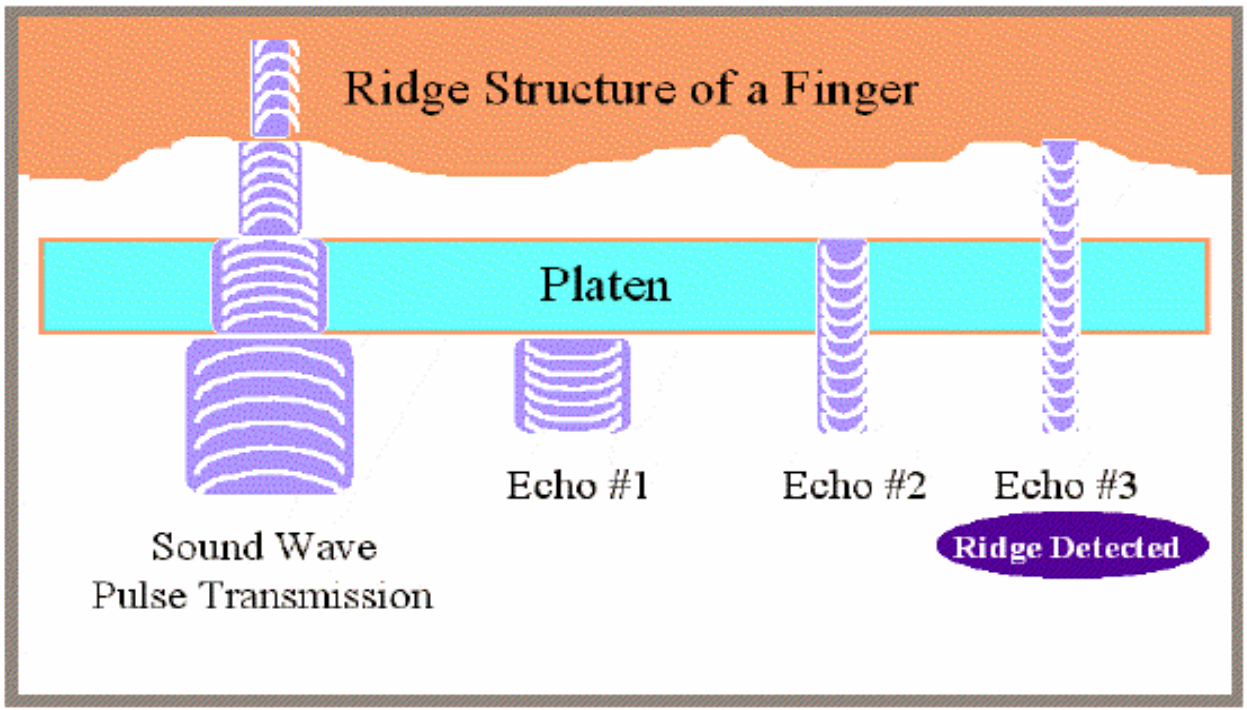
Source: Rowe (2005)

Touchless Optical Technology from TBS



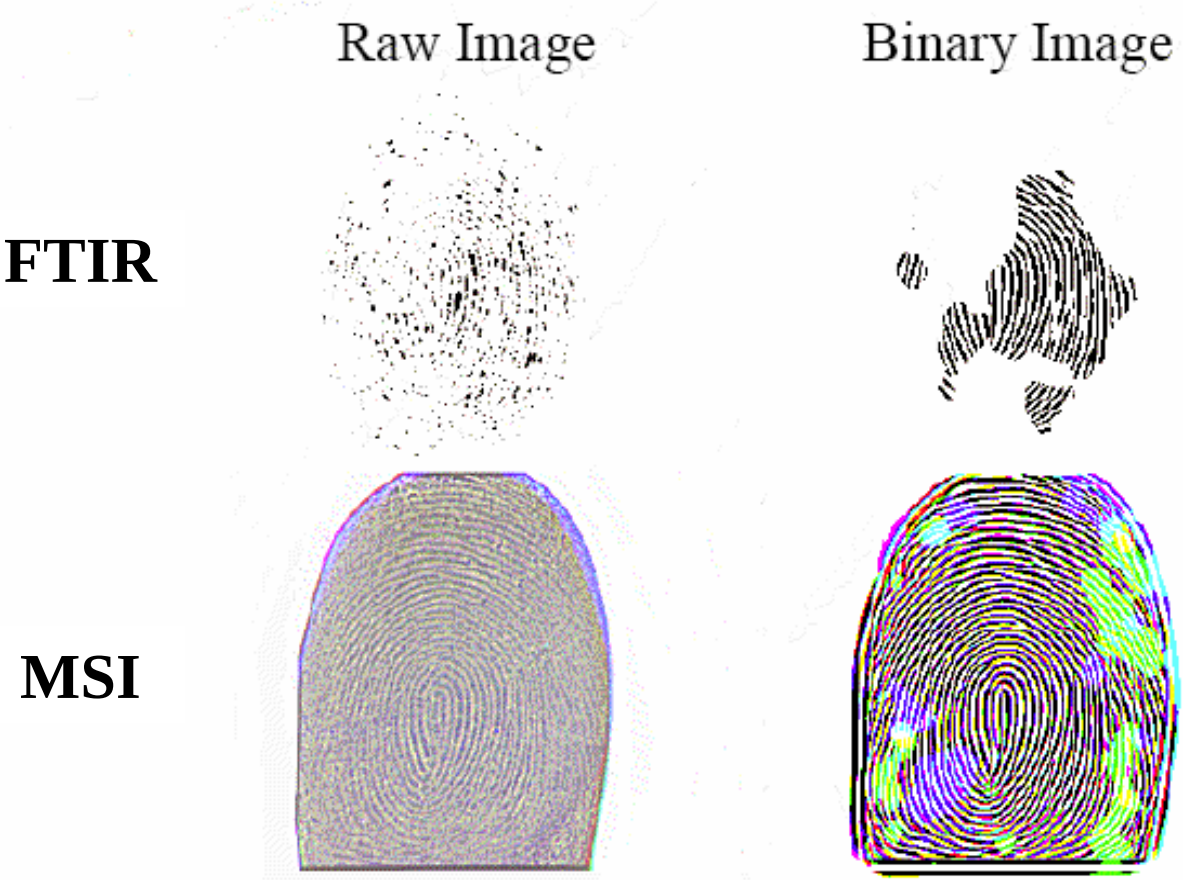
Source: TBS (2005)

Ultrasound Technology from Ultra-Scan



Source: Ultra-Scan (2005)

FTIR/MSI Flats Comparison: Lumidigm (dry finger)



Source: Rowe (2005)

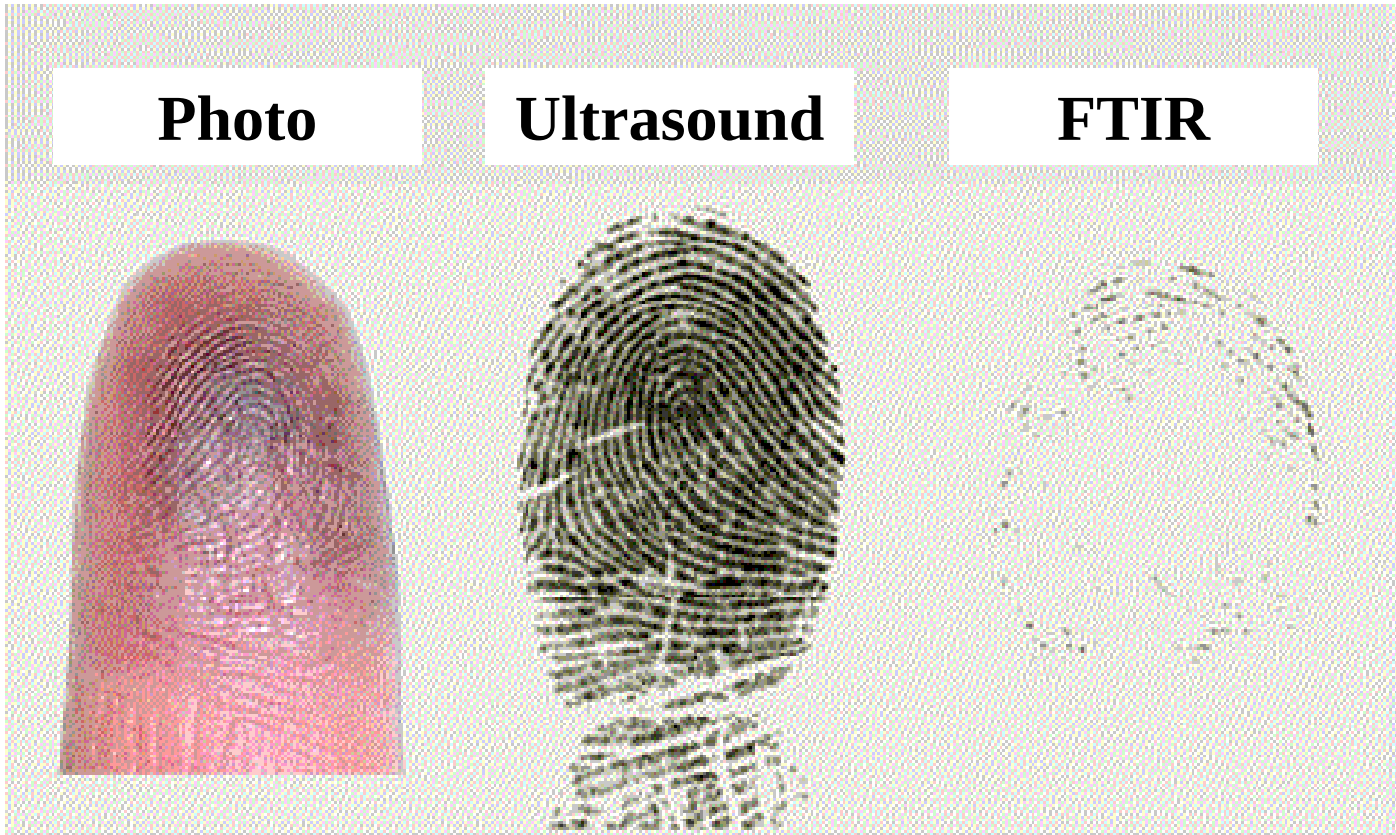
FTIR/TOI Flats Comparison: TBS (minutiae detail)

FTIR

TOI

Source: TBS (2005)

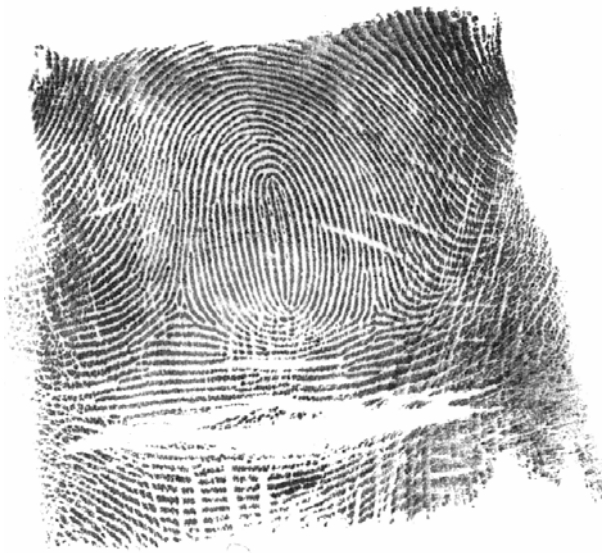
FTIR/USI Flats Comparison: Ultra-Scan (dirty finger)



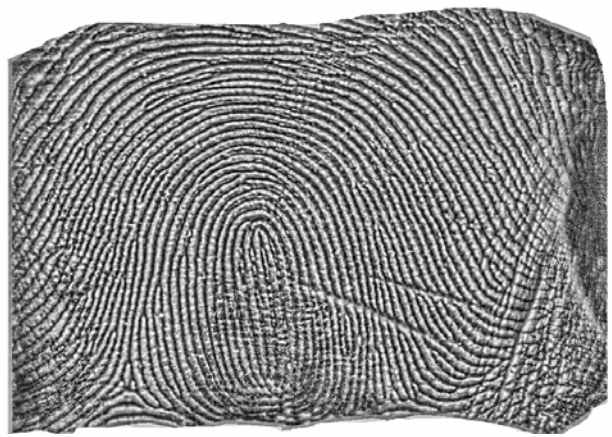
Source: Ultra-Scan (2005)

Ink/TOI Rolled Comparison: TBS (rolled prints)

Ink on Paper, desktop scan



TOI



Source: TBS (2005)

Current Practice: Levels 1 & 2 Quality Issues

- Ridge identification and patterns
- Minutiae
- Problems
  - Wetness, dryness
  - Dirt
  - Abrasion
  - Distortion caused by pressure
- Metrics for capture quality
  - Not preserved, sometimes not calculated

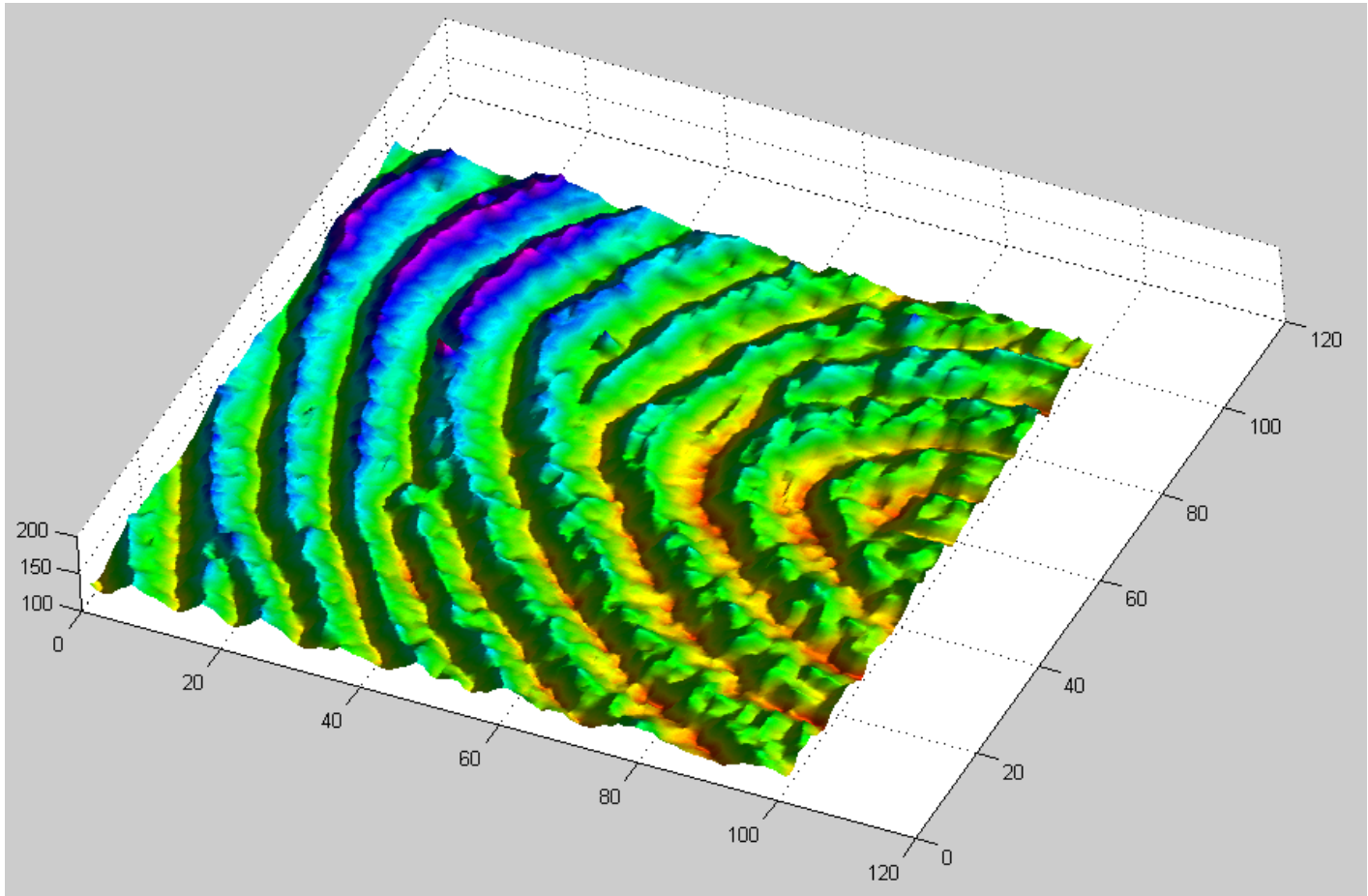
Current Practice: Level 3 Data Issues

- Latent print examination, not livescan
- Sweat Pores – Location, Size
- Incipient ridges
- Ridge shape
- Valley depth
- Intervening ridges

3-D Data

- Current livescan captures a 2-D impression of the 3-D fingerprint
- Each of the new technologies is fundamentally 3-D
  - MSI/Lumidigm: light scattering inside the finger
  - TOI/TBS: 5-camera stereoscopic (surround) photography
  - USI/Ultra-Scan: sound waves penetrate inside the finger below the surface

3-D Illustration from TBS

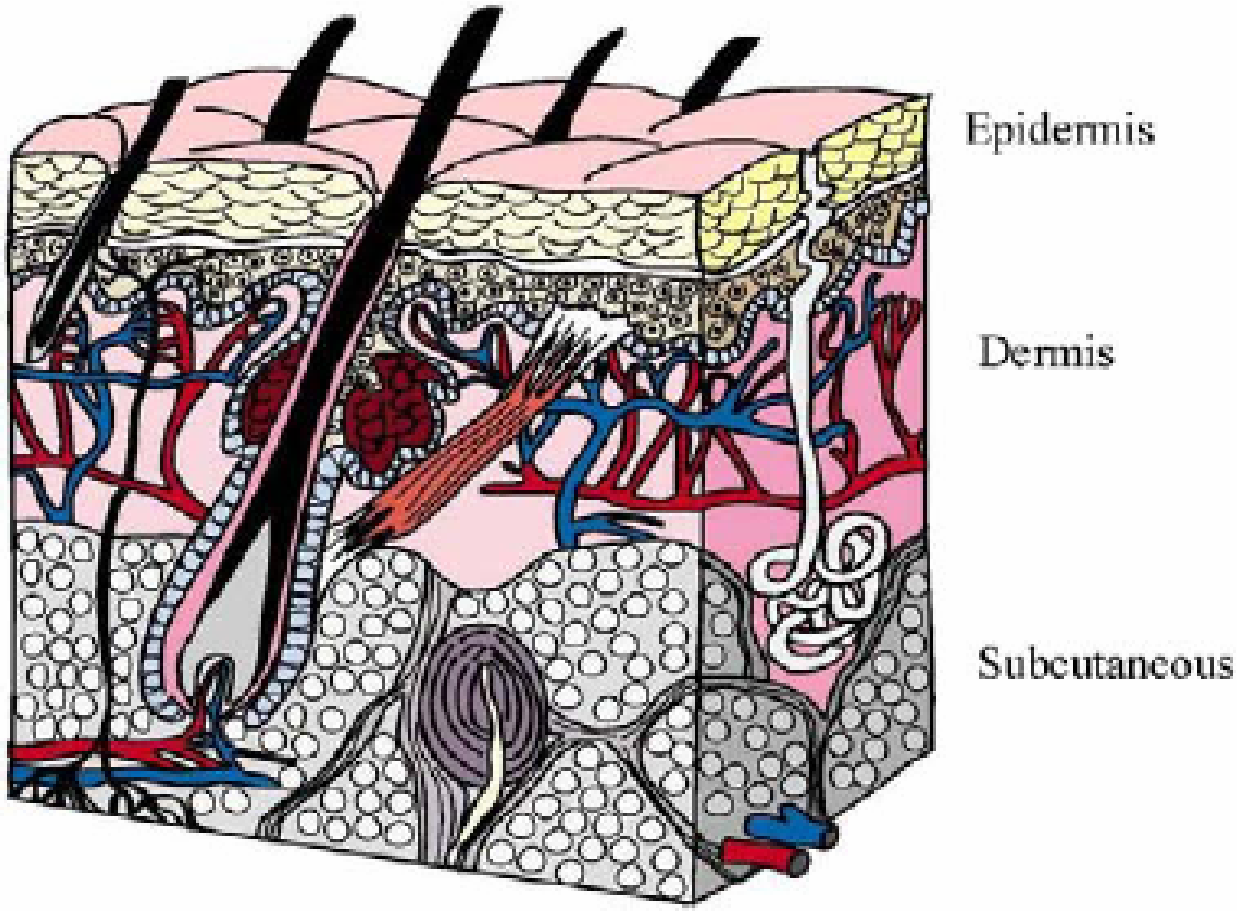


Source: TBS (2005)

Subdermal Data

- Ridge detail in the (non-living) epidermis
- Same ridge detail in the (living) dermis, under the epidermis
- Finger structure detail under the dermis: capillaries, arterioles, venoles
- Liveness testing possible
- Technologies applicable: USI, MSI

Subdermal Graphic from Lumidigm



Source: Lumidigm (2005b)

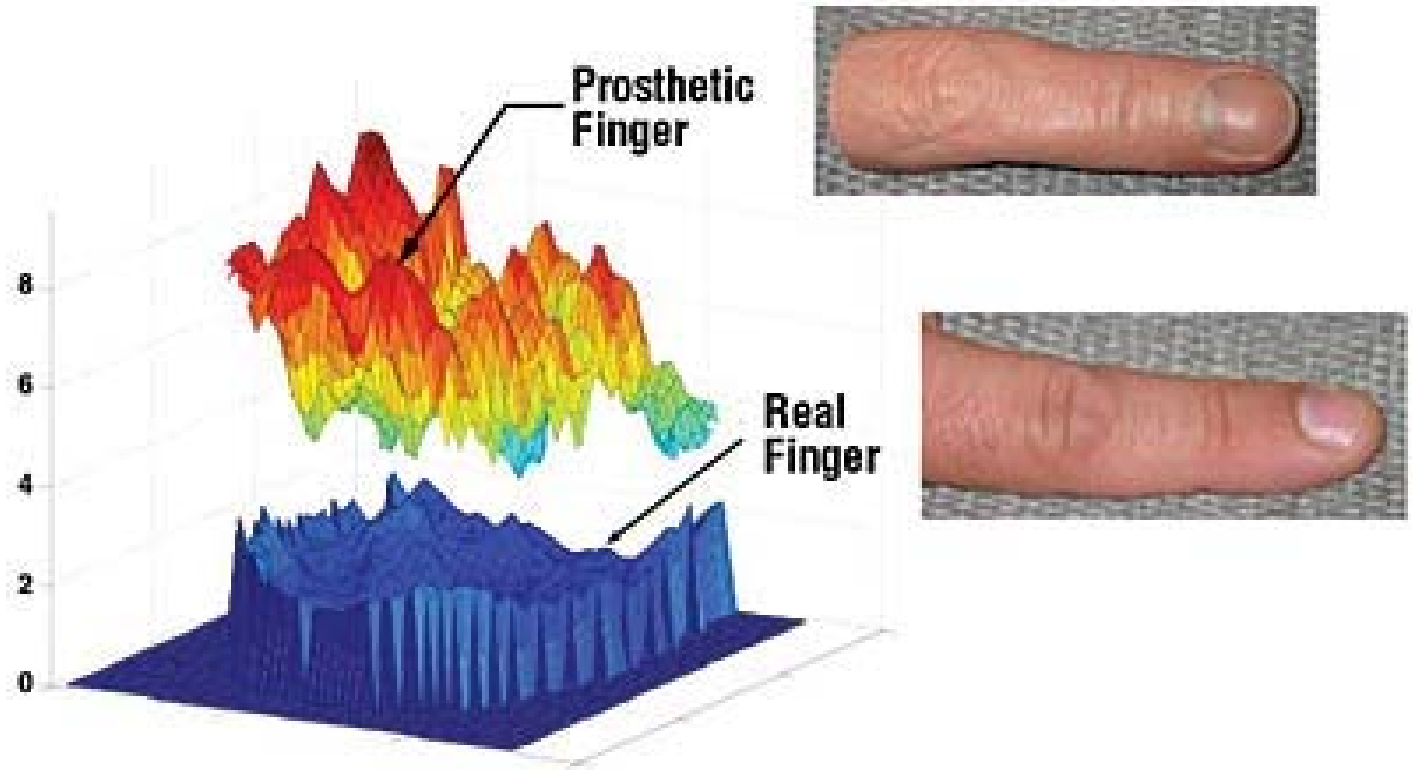
Liveness Testing Data

- Several seconds required
- Sweating pores
- Filled vs. collapsed capillaries, flowing blood, beating hearts
- Identification of characteristics of spoofing materials
- Relevant for Forensic Work?

Liveness Testing Demonstration from TBS (sweating pores)

Source: TBS (2005)

Liveness Testing Illustration from Lumidigm (prosthetic fingers)



Source: Rowe (2005a)

Impact of NIJ Fast Capture RFP

- ~15 active proposals
- New fast capture methods
- Supported by DoJ, DoD, DoS, DHS – explicitly broader than law enforcement
- All technologies, current and new, accepted
- Results of competition expected by mid-June

Adding Applications from DOD, DOS, DHS

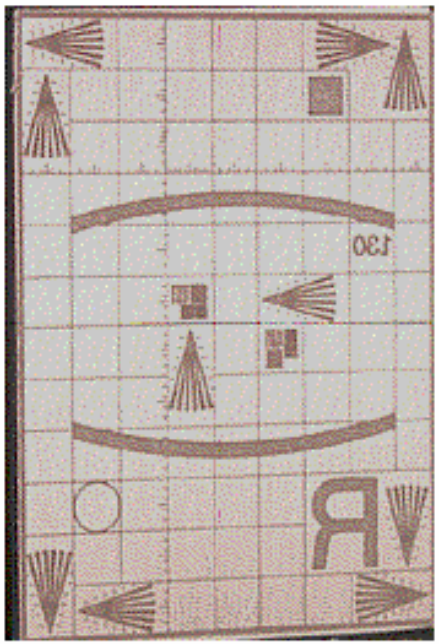
- Warfighter needs in the field - DoD
- Visas, passports, trusted traveler - DoS
- Border security, US VISIT - DHS
- One or two finger flats the current practice
- Unattended as well as attended capture
- Liveness testing clearly relevant

Anticipating Update of Appendix F for Certification of Livescan Devices

- Three next generation technologies highlighted here
- Other new technologies not yet identified
- Single and two finger flat capture devices
- Higher quality needs
- Liveness testing needs
- Fast capture needs

Certification Tools for Ultrasound Sensors from Ultra-Scan

Stainless Steel 3-D
Test Target



Prosthetic Finger
Test Target

Source: Schneider (2001), Ultra-Scan (2005)

Recommendations (A)

- Explicit standards for one & two finger plain impression livescan
- New fields for fingerprint image quality metrics
  - Require NFIQ
  - Allow additional quality measures with adequate documentation
- New fields for liveness testing
  - Test conducted
  - Results

Recommendations (B)

- New fields for Level 3 detail for livescan capture
- New fields for 3-D for livescan capture
- As in the past, FBI & NIST work should be tightly coordinated, for data transfer and certification
  - May need to expand certification efforts to include DOD, DOS, DHS
  - May need to conduct workshop comparable to this one on certification

References

- To be Supplied

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