



Quantifying Performance of Non-Contact Fingerprinting

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What is Live Scan?



What is Live Scan?

- Mature Technology – Introduced in the 80s
- Stationary subject
- Provides slap, plain or rolled fingerprints
- The operator is in contact with the subject
- The subject is in contact with the device
- Does not address current understanding of cultural sensitivities

What is Zero Contact Fingerprinting?



What is Zero Contact Fingerprinting?

- Not so new....
- An operator may not be required
- Subject keeps moving
- The operator does not touch the subject
- Captures prints from platen unprintable users
- Addresses global cultural sensitivity concerns

OTG in Operation



How good Are Non-Contact Prints?



AOS Zero-Contact print



Live Scan print

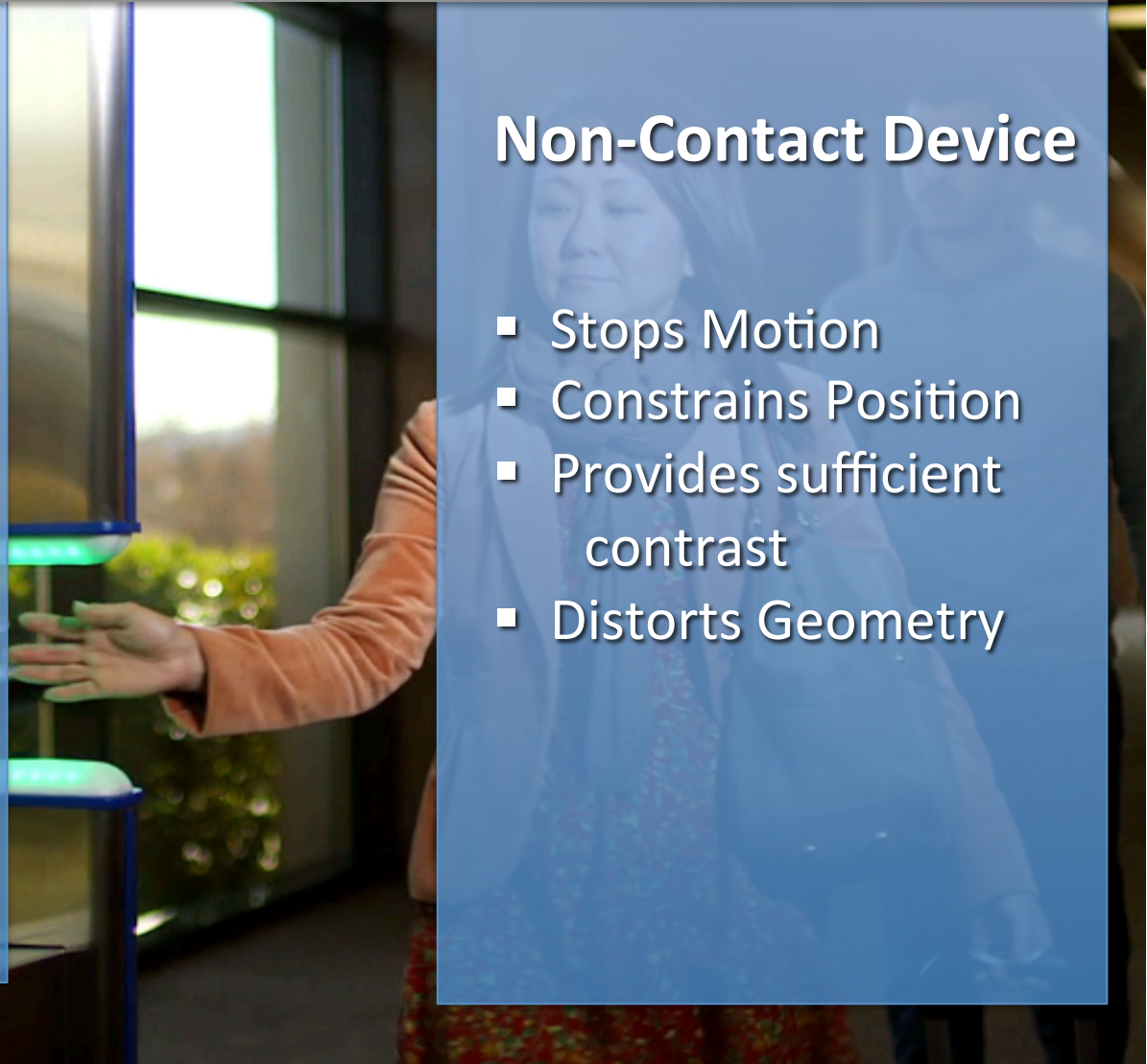
What are the differences?

Platen Device

- Stops Motion
- Constrains Position
- Imposes Non-Linear enhancement
- Distorts Geometry

Non-Contact Device

- Stops Motion
- Constrains Position
- Provides sufficient contrast
- Distorts Geometry



Quantifying Performance

- FBI Certification is the *de facto* standard
 - Image Quality, Human Examiner, Stress testing, User Experience, Pilot Study
- Image Quality Assessment
- Certified Human Examiner Reports
- Homogeneous Error Rates
- Heterogeneous Error Rates

In One Minute

Platen Device

- Operator begins working with one subject



Non-Contact Device

- Up to 50 people have provided four fingerprints each



Image Quality Metrics

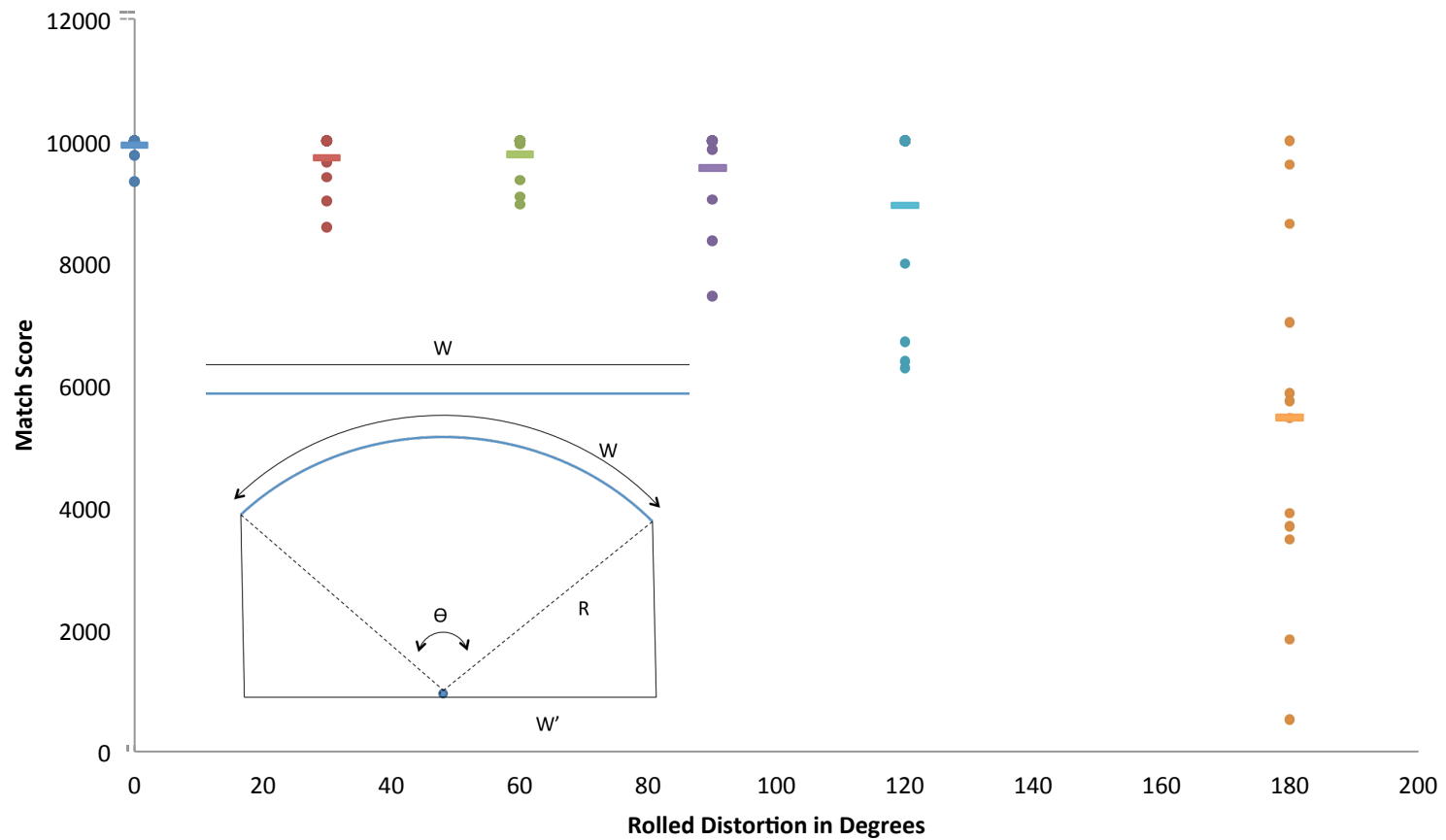
- Signal to Noise Ratio (shot noise limit)
- Uniformity (ambient lighting control)
- Grey Scale Distribution (contrast extraction)
- MTF (boundaries and motion)
- Geometric Distortion (imager -> object)

Perspective Distortion

- All contact based scanners distort fingerprints
- Matching software consequently deals with distortions, and has done so quite effectively
- The 3D fingerprinting world also tried to solve the distortion issue using hardware and imaging techniques
- Software won

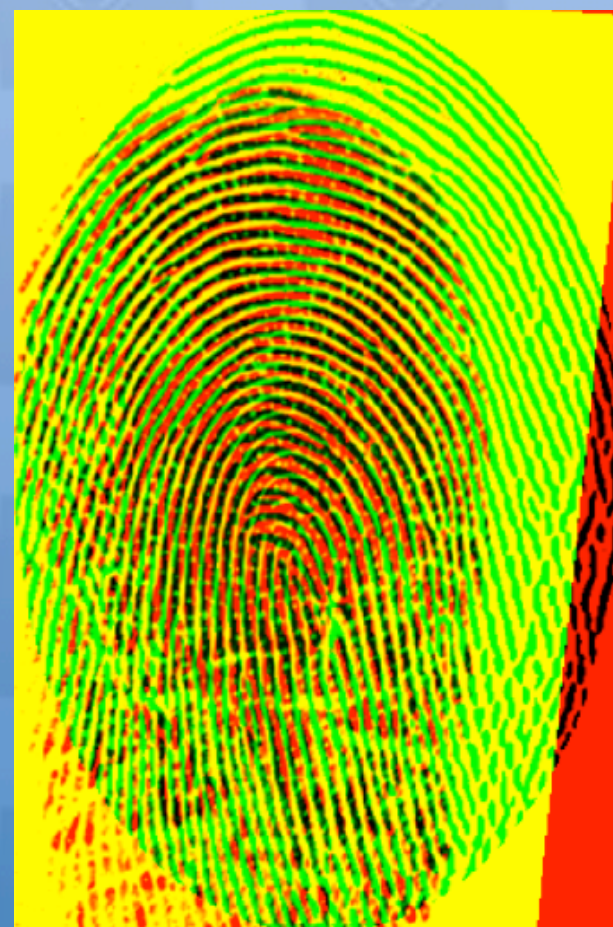
Impact of Distortion

Match Score vs Rolled Distortion



Area

- AOS Non-contact captures more than typical flats, but not as much as rolled
- Increased area means lower error rates
- Delta regions
- Right side/Left side Issues



MTF

- Based on typical finger topology... approximately 45 degree max angle
- Perspective Distortion indicates an MTF frequency compression of 1.4 at 45 degree angle of incidence
- Have to get the discrete sampling rate and analog resolution balance right

Pilot Studies

- Certified Human Examiner Considerations
- Homogeneous Matching Error Rates
- Heterogeneous Matching Error Rates
- The “invisible” subjects
 - <http://www.hindawi.com/journals/bmri/2012/626148/>
 - <http://www.timegoesby.net/weblog/2013/09/elders-and-fingerprint-technology.html>

Pilot Studies

- NIJ Sponsored Study
- WVU De-duplicated

Probe Set	Gallery Set	True Match Rank 1	
CMR2	CMR2	100%	Reference
SEEK Rolled	CMR2	98%	Contact Rolled
SEEK Plain	CMR2	95%	Contact Plain
BioSled Plain	CMR2	94%	Contact Plain
OTG 1.0+	CMR2	92%	Non-contact Plain
FOTF	CMR2	92%	Non-contact Plain
TBS HT1	CMR2	92%	3D Non-contact

Research Interests

- High Quality Interoperability Data
- NFIQ 2.0
- Improving Scans on the 5 to 10 Percent
- Comparison to 3D Topographic Scans
- Impact of Ridge Phase and Shadowing
- Impact of 3D Objects/Targets

Working Together...



Suitcase Points

- Non-contact prints are reliable and trustworthy for verification and authentication
- Image quality tests and methodologies do not differ significantly from platen based technologies
- High user acceptance
- Pilot studies and CRADA research topics are welcome

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