# NIST Latent Fingerprint Workshop II

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# Vendor Panel Topics

## First Session (19 March) - Lights-Out Latent Processing

- 1a - Image-only latent matching
- 1b - Automated match determinations for image-only or feature-based latent matching
- 1c - Using increased automation and business practices to make more effective use of latent examiners

## Second Session (20 March) - Feature-Based Latent Processing

- 2a - The CDEFFS extended feature set specification
- 2b - Interoperable latent AFIS feature sets, in light of the National Academies Recommendation #12
- 2c - How to test extended feature sets for latent fingerprint matching

# (1a) Notes on Image-only Latent…

- **Goals for image-only matching**
  - **Reduce manual workload**
    - at the expense of accuracy and system cost
    - back record conversion, data migration, or backlog catch up
  - **In some cases increased accuracy**
    - fuse with manual encoding or non-native markups
      - improved hit rate 5% points in one internal test
    - Grayscale/texture validation matches on top candidates
- **Lights out performance with ELFT is possible with existing AFIS systems. But is that good enough?**
  - **Question can be answered by looking at the cost. Cost effectiveness:**
    ***Cost of Missed Hit * FNMR < Examiner Cost Reduction - Incr System Cost***
  - **Sometimes hard to place value on missed hit… but the other parameters are easy to calculate**

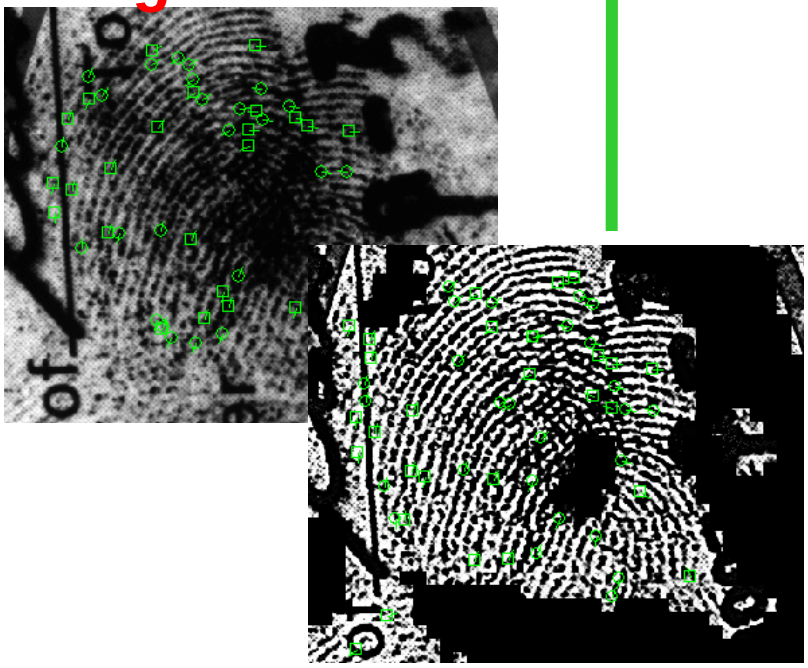
# (1a) Notes Lights-Out (LO) Latent…

- **LO success depends largely on ability to auto markup the latent**
  - Auto is roughly 5% less accurate than human encoding
  - **Strong dependency on quality**
- **Impact of auto-encoding: Does auto encode shift the workload to adjudication?**
  - Non-hit goes to unsolved latent DB and could likely require expert review of encoding anyway
  - A reliable quality metric and match score is key to successful LO
  - Existing quality metrics are a good start (even NFIQ if there is some pre-processing - see table)
- **Latent specific pre-processing of images can help prepare the latent images for LO with existing AFIS systems**
  - Improvements reflected by quality metrics
  - Improves auto feature extraction of latent
- **Note that a LO latent encoder will often err towards more false minutiae in order to get a high % of true minutiae**
  - The goal is to reduce the FNMR
  - "When in doubt , leave it out" - NOT TRUE

## Latent Quality

| SD 27 | Orig NFIQ | Processed NFIQ |
|---|---|---|
| Good | 3.9 | 4.3 |
| Bad | 3.7 | 4.6 |
| Ugly | 3.7 | 4.7 |

Original



Pre-Processed

# (1b) Automated Match Determination

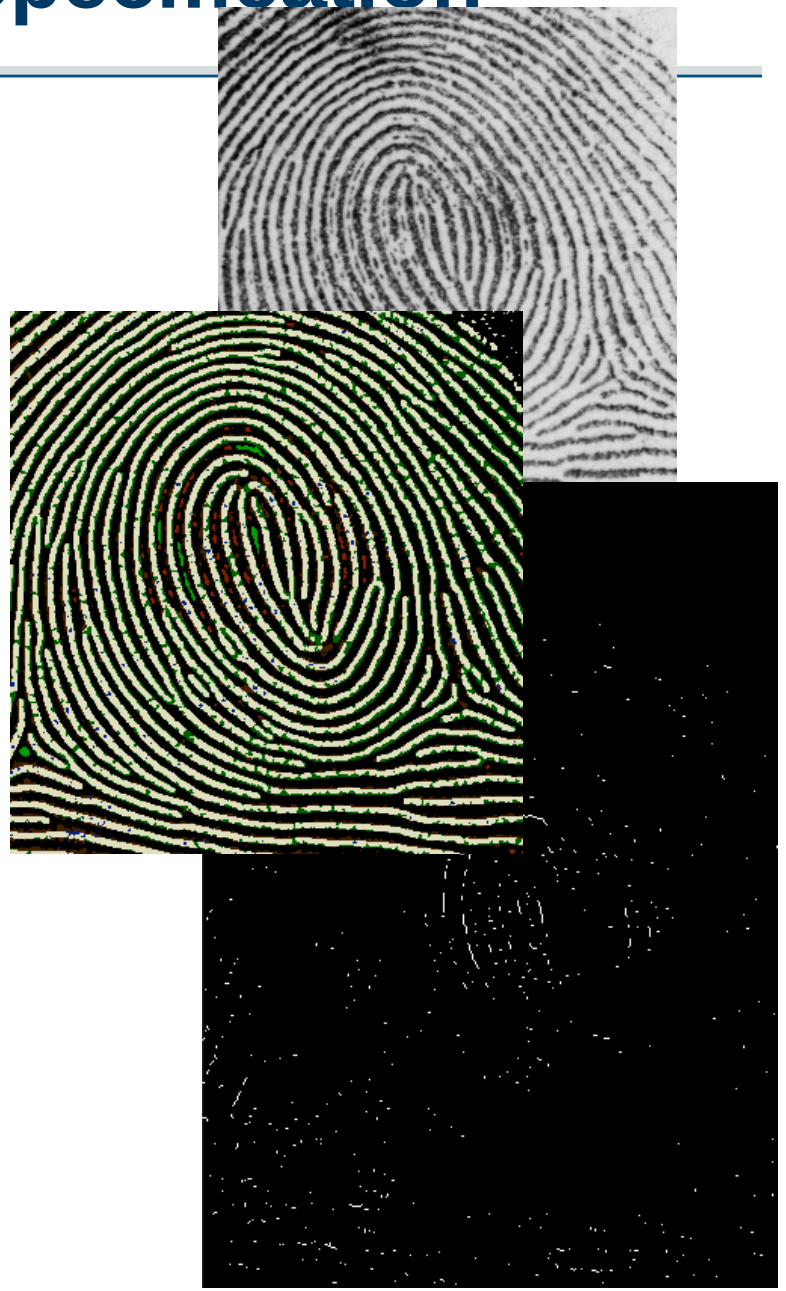
- **Automated Match Determination here means that an algorithm flags matches to be sent to an operator for further investigation, while other matches are classified as non-hits.**
- **This is already in place for reverse latent searches (match to an unsolved latent DB)**
- **To use in a forward latent search, there will be a penalty in accuracy over manual adjudication**
  - **ELFT results: a 50% reduction in FMR = 10% increase in FNMR**
  - **The technology is not quite there yet if accuracy is top priority**
- **Adjudication is often faster than markup.**
  - **Perhaps more time savings in the encoding**
  - **This is less the case as database size grows and probe quality decreases**
- **Performance can be improved with**
  - **Multiple samples**
  - **Fusion of multiple algorithms**
- **Quality does play a role in automated match determination**

# (1c) Optimal Automation for LO

- **Suggest a quality (drives FNMR) and priority (cost of miss) driven workflow**
  - **High priority – manual encode – no auto match determination**
  - **Low priority – auto encode**
    - High Quality - auto match determination
    - Low Quality – manual match determination
  - **Low latency request – all auto, send response, then reprocess with above rules**
- **Use a cost driven approach to determine operating 'thresholds' in auto match determination.**
  - **Decision set at point where FNMR is**
    ***FNMR < (Examiner Cost Reduction - Incr System Cost)/ Cost of Missed Hit***

# (2a) CDEFFS EFS Specification

- **Likely vendor impact**
  - **Examiner workstation support**
  - **ANSI/NIST support**
  - **Automatic extraction of features**
    - Published and public domain implementations for some features
  - **EFS used for matching**
    - Template size considerations if used for ‘main’ search
    - Use only for validation stage of the search – extract on fly or just use grayscale directly
- **EFS will allow an additional level of interoperable AFIS performance (accuracy)**



# (2b) Interoperable Latent AFIS Feature Set

- **Perhaps define ‘effort levels’. For instance**
  - Effort 0 = image only (used for lights out)
  - Effort 1 = image + hints + ROI
  - Effort 2 = Effort 1 + minutiae + dots + distinctive features + other…
  - Effort 3 = Effort 2 + ridge tracing + other
  - Effort 4 = Effort 3 + level 3 details
- **AFIS systems can publish**
  1. Maximum supported effort level
  2. Minimum required effort level
- **Let’s see from ELFT-EFS what features have potential**
  - Many extended features are only useful in ‘good’ quality prints where existing minutiae matching is already effective
- **Is vendor consensus on a subset of CDEFFS-EFS possible (or needed in light of ELFT results)?**

# (2c) Testing EFS for latent matching

- **Generally follow ELFT protocol / metrics**
  - CMC
  - Selectivity / Alarm / 1:N DET
  - Match speed not limited, but reported
- **How do we separately measure the contribution of various features and hints?**
  - Search with different aspects of the markup removed?
- **Some R&D time may be needed to fully take advantage of EFS in an efficient way. Ongoing testing would be 'nice'.**
- **Feedback useful for technology advancement**
  - Allow tuning or make representative data available
  - Allow SDK to generate optional diagnostic information for feature overlays (.png), individual feature matcher scores (.xml), etc..