Motivation and Approach

- A scientific measure of confidence is needed to support an examiner’s decision, particularly for latent prints (Daubert v. Merrell Dow Pharmaceuticals, 1993)
- Latent prints are often blurred or partial, so we need to...
  - investigate causes of distortion
  - utilize grayscale information, unlike many AFIS implementations
  - utilize information from Levels 1, 2, and 3

Quality Assessment based on Minutia Detection

- The NBIS "remove false minutiae" step utilizes 9 separate software filters \( \Rightarrow 512 \) different ON/OFF combinations
- Our idea: Higher-quality minutiae should survive processing by more filter combinations
- Experiment: We investigated a case from NIST Special Database 27
  - A human examiner selected 16 minutiae from a latent print
  - The examiner then identified 14 matches in a ten-print image from the same subject
  - Our approach found 8 of those 14 minutiae to be of high quality

Future work: Incorporate information related to 2-D point distributions, minutia orientations, ridge-based connectivity

Distortion from Motion Blur

- In our simulations, minutia-based feature matching could tolerate blur up to about 8 pixels
- Motion blur filter (frequency domain):

\[
H(u,v) = \frac{T}{\pi(ua + vb)} \sin(\pi(ua + vb)) e^{-\gamma T^2}
\]

\( T \) - amount of blur
\( a = \) blur in \( x \) direction
\( b = \) blur in \( y \) direction
\( (a, b) \) determines direction of blur

Distortion from Skin Elasticity

- Small movements of the finger cause nonlinear changes in the imaged print
- These effects can be modeled using assumptions of skin elasticity
- We have developed a new software tool, fpCreator, which allows us to experiment with these concepts

Analysis of Friction Ridges

- Minutiae alone are not enough, especially when dealing with latent prints
  - We define ridge component as a connected portion of a friction ridge image that is terminated by two minutiae
  - Let a ridge connection refer to a ridge component together with its two associated minutiae
  - Ridge connections can be used to improve the confidence of matched minutiae

Database Design and Image Synthesis

- We have proposed a database schema to describe fingerprint information, distortions, and experimental data
- Motivated by NBIS:
  - o information from individuals
  - o description/parameters of the experiment with associated results
  - o time and evaluation of the experiment
  - o information from original (latent) images and distorted images:
    - o parameters used to create the distorted images
    - o computed distance between two compared images

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