Research Challenges in Biometrics

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Recent Trends That Motivate Academic Research

- Video surveillance
  - Cameras everywhere
- New modalities
  - Gait, vein, ear, ECG
  - Molecular: Rapid DNA, hand bacteria
- Cross modality
  - Matching one modality against another
- Mobile/cloud biometrics
  - Sensors on mobile devices (“BYOD”)
  - Processing in the cloud
- Massive Systems (e.g., UIDAI)
- Privacy concerns and public acceptance
Biometric Template Protection

- **Goals:**
  - Non-invertibility
  - Revocability
  - Nonlinkability

- **Challenges:**
  - Scalability
  - Key management infrastructure
  - Metrics for quantifying privacy
Mitigating Presentation Attacks

- Biometrics susceptible to presentation attacks:
  - Spoofing
  - Replay attack
  - Altered biometrics

- Countermeasures:
  - Automatic liveness detection
  - Interactive capture protocol
  - Multifactor; Multi-modal biometrics

- Having common evaluation methodologies is important.
  - Benchmarking competitions are useful
Rapid DNA
From Benchtop to Booking

- Primarily for booking stations (buccal swabs as input).
- Low SNR of degraded samples limits forensic use of rapid DNA.
- Small amounts of DNA can be fused with fingerprints.
- Other molecular modalities are possible, including hand bacteria.

3+ hrs

45min – 1hr

http://integenx.com/products/rapid-dna/
Cross-Spectral Face Recognition

- Matching thermal probe image against a visible image gallery.
- A training set available of valid thermal-visible pairs.
- Goal is to learn a common latent feature subspace.
- Solution uses Coupled Dictionary Learning and Coupled Deep Neural Networks.
What is CITeR?

• Multi-university research collaborative
  Sites: WVU, Clarkson, Arizona, and Buffalo.
  Other Research Partners: Michigan State and Idiap (Switzerland)

• Operates as an NSF Industry/University Research Center
  Industry and government partners join on a membership basis.
  Research projects selected by members at semi-annual meetings.
  NSF covers administrative costs, so no overhead for members.

RESEARCH AND EDUCATIONAL FOCUS
The importance of individual identity in a networked global society

SCOPE
Physiological, Behavioral, and Molecular Biometrics
CITeR Affiliates

- Aware
- Borders
- DoD—Defense Forensics and Biometrics Agency
- DoD—Defense Intelligence Agency
- DoD—Research & Engineering Enterprise
- DHS—Office of Biometric Identity Management (OBIM)
- DHS—Science & Technology
- Federal Bureau of Investigation
- Laurea Institute
- Morphotrac
- National Security Agency
- NexID Biometrics, LLC
- Northrop Grumman
- Qualcomm
- Raytheon BBN Technologies
- SRC, Inc
- US Army ARDEC
Research Datasets

Q-FIRE 2
Waiting in line (multiple subjects) & Passing items

Request data @ http://clarkson.edu/citer/resources
Research Portfolio Snapshot

Multimodal - Cloud
- Fusion score/feature level, quality
- Indexing
- System level design & evaluation
- Privacy-Security
- Cloud computing, Multi-core
- Statistical performance evaluation

Fingerprint
- Level 3
- Liveness
- Anonymous biometrics
- Biometric cryptosystems
- Quality

Palmprint
- Level 1, 2, 3
- Partial

Iris
- Non-ideal, off angle
- Unconstrained
- Iris at a distance
- Multispectral
- Quality

Credibility
- Kinesic
- Audio
- Linguistic

Multispectral
- Fusion
- Cross

Molecular
- DNA
- VOC
- Bacterial

Others
- Voice
- Conjunctival vascular
- Tattoo, body markings
- Soft biometrics
- Age progression
- Cardiorespiratory

Face
- Matching, quality
- Unconstrained
- 3D Face
- Face in a crowd
- Tinted glass
- Cosmetics

Fingerprint
- Level 3
- Liveness
- Anonymous biometrics
- Biometric cryptosystems
- Quality