Forensic Science and Information Technology at NIST

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Information Technology Laboratory (ITL)

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FORENSICS @ NIST
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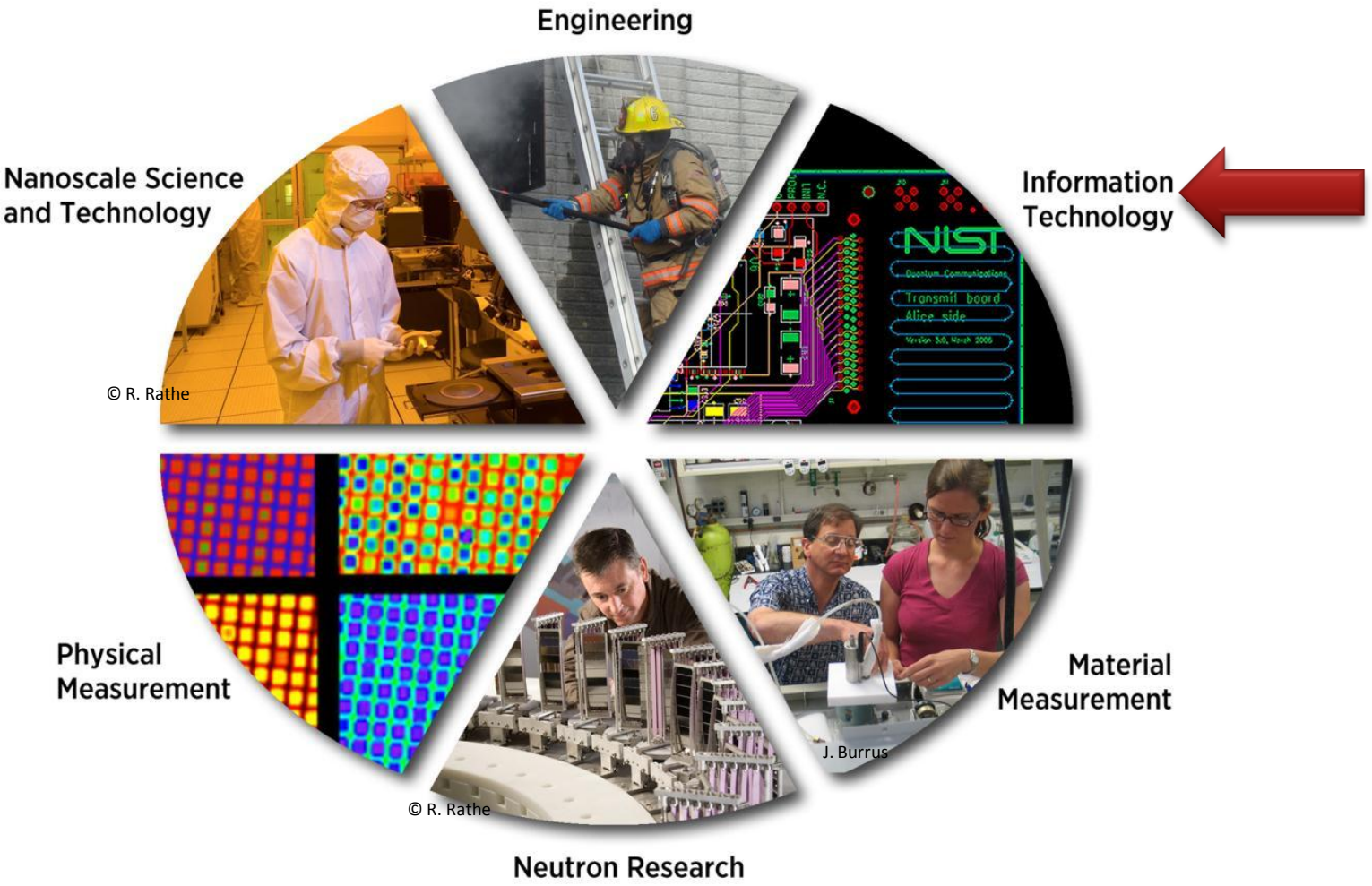
NIST Laboratories



Information Technology Laboratory (ITL)

ITL Mission:

To promote US innovation and industrial competitiveness by advancing

measurement science, standards, and technology

through research and development in

information technology, mathematics, and statistics.

- Cloud Computing
- Complex Systems
- Forensic Science
- Health Information Technology
- Trusted Identities in Cyberspace
- Pervasive Information Technology
- Security Automation
- Quantum Information
- Smart Grid
- Voting Standards
- Virtual Measurement Systems
- Biometrics
- Computer Security
- Math
- Networking
- Statistics
- Software
- Usability
- Information Access

ITL Role in Forensic Science

Advance measurements and standards infrastructure for forensics through information technology, math and statistics.

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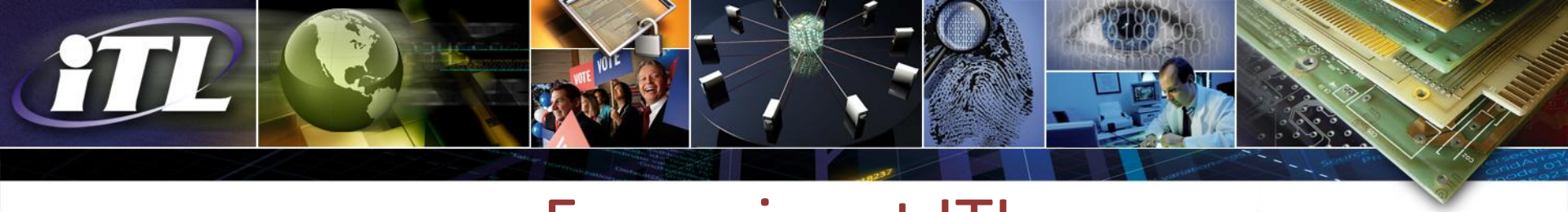
– “roads and bridges” –

ITL Role in Forensic Science

Advance measurements and standards infrastructure for forensics through information technology, math and statistics.

Goals:

- Better understand and improve accuracy and reliability
- Human observer bias and sources of human error
- Provide scientifically validated bases for forensic methods and standards
- Statistical foundations for forensic science
- Establish measures of uncertainty for forensic analyses
- Develop automated computing methods for forensic analyses
- Enhance the usability and interoperability of forensic systems



Forensics at ITL

Measurements, Standards, & Technology

- Human Identity
  - Latent fingerprints
  - Face recognition
  - Speaker recognition
  - Palm prints, plantars (footprints)
  - Iris recognition, DNA, tattoos
  - Dental records, bite marks
- Digital Forensics
  - Computer forensics
  - Mobile device forensics
  - Cybersecurity incidents
  - Cloud computing forensics
- Multimedia Forensics
  - Video/image/audio analytics and content extraction
  - Image/video quality
- Statistical Science
  - Statistical analysis for
    - Illicit drug measurements
    - Markings on bullets & casings
    - Ballistic markings database and matching

ITL Forensics Products and Services - 1

- **Metrology for forensics**
  - Measures of

    performance, data quality, reliability, accuracy, validity
  - Examples:
    - quality metrics for fingerprint images, face images, voice samples, surveillance images/video
      - What is purpose of quality measure? How do you know it's good?
    - scientifically characterize image enhancements for latent fingerprint images
    - measures of performance for biometric matching systems
    - measures of performance for multimedia search and interpretation systems
    - metrology for computer forensics tool testing

ITL Forensics Products and Services - 2

- **Reference methods and technologies for forensic science**
  - Examples:
    - reference software for quality metrics
    - software for scoring accuracy of matching systems or multimedia analysis systems
    - reference fingerprint matcher
    - evaluation methodologies and procedures
      - testing design, metrics application, data collection & formatting
    - reference framework for cloud forensics
    - Computer Forensics Tool Testing test software and procedures

ITL Forensics Products and Services - 2

- **Reference methods and technologies for forensic science**
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- **Reference data sets**
  - Examples:
    - NIST Special Database 27: Fingerprint Minutiae from Latent and Matching Tenprint Images
    - NIST Special Database 32: Multiple Encounter Dataset (for face recognition)
    - National Software Reference Library – Reference Data Set for identifying computer files
    - Computer Forensic Reference Data Sets (CFReDS) – tool validation, proficiency tests, etc.
    - Public data sets for developing automated biometric matching or multimedia analysis systems

ITL Forensics Products and Services - 3

- **Statistical foundations for forensic science**
  - Uncertainty measurement, error rates, precision, uniqueness
  - Examples:
    - NIST participation with BIPM in GUM and VIM to provide basis for measuring uncertainty
    - measurements of mass of seized drugs
    - limits of detection for presence of drugs
    - analysis and modeling of matching scores for forensic identification
    - uncertainty for 11 SRMs: drugs of abuse

GUM: Joint Committee for Guides in Metrology. ***Evaluation of measurement data – Guide to the expression of uncertainty in measurement*.** International Bureau of Weights and Measures (BIPM), Sèvres, France, September 2008.

VIM: Joint Committee for Guides in Metrology. ***International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*.** International Bureau of Weights and Measures (BIPM), Sèvres, France, 2008.

ITL Forensics Products and Services - 4

- **Human bias, errors, and decision-making**
  - Examples:
    - Work-flow studies and decision-making of practitioners
    - Usability studies (effectiveness, efficiency, satisfaction)

ITL Forensics Products and Services - 5

- **Rigorous testing and evaluation of forensic technologies**
  - To publicize and improve accuracy, reliability, and interoperability of forensics
  - Technology evaluation test beds
  - Examples:
    - Evaluation of biometric matching & search technologies
      - latent fingerprints
      - face recognition
      - speaker recognition
      - iris recognition
    - Evaluation of technologies for content-based search and interpretation of multimedia
      - searching objects and events in multimedia
    - Computer forensics tool testing

ITL Forensics Products and Services - 5

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- **Challenge problems to foster technology innovation**
  - Examples:
    - Face Recognition Grand Challenge
    - Multiple Biometric Grand Challenge
    - Multimedia evaluations
    - Speaker recognition evaluations

ITL Forensics Products and Services - 6

- **Standards and best practices**
  - Work with Standards Development Organizations
    - consensus documentary standards
  - Testing for conformance to standards
  - Examples:
    - ANSI/NIST-ITL 1-2011, Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information
      - Forensic data interchange formats
      - Mobile devices for data collection and transmission (Best Practices)
    - Conformance Test Architectures and Test Suites
    - ISO/IEC SC37 – Biometrics (International Standards)
    - INCITS M1 – Biometrics (National Standards)
    - Cyber attack incident response and handling (Best Practices/Guidelines)

Introduction to Sessions

- Computer and Multimedia Forensics
  - Computer forensics overview – Barbara Guttman
  - Multimedia forensics overview – next slide
- Fingerprints & Biometrics
  - Overview – Mike Garris

Overview of Multimedia Forensics at NIST

(Video, Audio, Images, Text)

- Content-based event detection in video
  - Events: people engaged in activities
  - Grand challenge evaluations
  - Help investigators find events in large amounts of data
- Content-based video search
  - Grand Challenge evaluations
- Image/video quality for forensic examiners
  - Human interpretability scale

Content-Based Event Detection in Video

- Surveillance Event Detection
  - Detect all occurrences of a pre-defined event
    - Machine learning of events
  - Surveillance video
- Multimedia Event Detection
  - Search multimedia recordings for user-defined events
  - E.g., internet multimedia (i.e., clips containing both audio and video streams)
  - Event recounting – summarize key evidence used by automated system to detect the event

Content-Based Video Search

- Semantic indexing
  - Automatically assign semantic tags to video segments
    - E.g., “beach,” “car,” “sky,” “running,” “sports,” etc.
    - fundamental technology for filtering, categorization, browsing, search, etc.
- Known-item search
  - Search for a video in a collection given a description of its contents
- Instance search
  - Find video segments of a specific person, object, or place, given one or more video examples of the specific item
- Copy detection
  - Given a reference video collection, determine if and where a possibly modified portion of a reference video is contained in a query video

Posters (Lecture Room D)

1. Computer Forensics (includes NSRL and CFTT)
2. Human Assisted Speaker Recognition
3. Using Attack Graph and Evidence Graph in Computer Forensics Examinations
4. Instance Search, Copy Detection, and Semantic Indexing at TRECVID
5. Developing a Forensics Image Examination Rating Scale
6. Evaluation of Latent Fingerprint Technologies (ELFT)
7. Evaluation of Fusion Methods for Latent Fingerprint Matchers
8. Biometrics Research Lab to Support Standards Development and Measurement Science
9. Biometric Sample Quality – The Push Towards Zero Error Biometrics
10. ITL – Standards Development Organization (SDO) of ANSI/NIST-ITL Biometric Interchange Standard – 25 Years of Building Community Consensus with Global Impact
11. Using Challenge Problems to Advance Face and Iris Recognition
12. Assessing Uncertainty in Measurement
13. 3D Shape Analysis, Retrieval and Metrology

ITL Forensic Science Website

www.nist.gov/itl/forensic.cfm

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