Forensic Photographic Comparison Analysis

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Forensic Photographic Comparisons Outline

- Recognized discipline
- What is it?
  - Brief History
- How is it done? (Technique)
- Examples
- Limitations
  - What it is not
  - What should be done to support it?

ASCLD/LAB and Digital & Multimedia Evidence

- ASCLD/LAB now recognizes “Digital and Multimedia Evidence” as a discipline subject to accreditation.
- Subdisciplines of “DME” include:
  - Computer Forensics
  - Forensic Audio
  - Video Analysis
  - Image Analysis

SWGIT & Forensic Image Analysis

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Section 12

Best Practices for Forensic Image Analysis

OBJECTIVE

The objective of this document is to provide personnel with guidance regarding practices appropriate when performing a variety of analytic tasks involving images, regardless of the knowledge domain that is the subject of analysis.

SWGIT POSITION ON FORENSIC IMAGE ANALYSIS

Forensic image analysis is a forensic science. It has been practiced since the early days of photography, dating at least to 1851 when Marcus A. Root conducted the first documented example of Forensic Image Authentication. Through microscopic examination, Root revealed that the color daguerrotype "process" promoted by Reverend Levi Hill was actually the product of hand coloring, not a breakthrough in photographic science (Davis, Photography, Brown & Benchmark, 1995). In addition to being an accepted scientific practice in the forensic community, image analysis is also recognized in other disciplines including medicine, intelligence, geology, astronomy, agriculture, and others.

Forensic Image Analysis

- Information Extraction (through processing)
  - License plate numbers, clothing markings, etc.
- Photogrammetric examinations
- Image Authenticity examinations
- Forensic Photographic Comparisons
  - Facial/person-to-person comparisons
  - Object comparisons (clothing, vehicles, weapons, etc.)
  - Image-to-camera comparisons

SWGIT & Photographic Comparisons

Photographic Comparisons

Photographic comparison is an assessment of the correspondence between features in images and known objects for the purpose of rendering an expert opinion regarding identification or elimination (as opposed to a demonstrative exhibit). Examples of photographic comparisons include, but are not limited to:

- A facial comparison between an unknown subject depicted in a surveillance image with an identified suspect;
- The comparison of objects such as vehicles depicted in surveillance images with those recovered in an investigation;
- The comparison of a questioned image with a known camera to determine if the image was captured using that camera.

Photographic comparisons are frequently referred to as "side-by-side" comparisons since they usually involve a comparison of class and individualizing characteristics in imagery. The scientific processes involved in photographic comparisons are comparable to those used in other forensic disciplines such as fingerprint analysis. An application of the scientific method applied to photographic comparisons is ACE-V (Analysis, Comparison, Evaluation – Verification). Statistical analysis can be used as a component of the evaluation stage of ACE-V, but is not required.

Forensic Photographic Comparisons

- Image-to-image comparisons not new, or unique to forensics:
  - Astronomy
    - Change Detection (planet searches)
  - Geology (Photo-geology)
    - Inter-comparisons (Tectonic/impact processes, etc.)
    - Change Detection (volcanism/water/dust)
  - Military/Intelligence/Security Applications
    - Cuban Missile Crisis
    - Imposter Detection
    - DHS and State Department Applications

Forensic Photographic Comparisons

- Image-to-image or image-to-object comparisons not new to forensics:
  - Latent prints
  - Footwear impressions
  - Tire impressions
  - Questioned Documents
  - Firearm and Toolmark exams
    - Firearm identifications from photographs
- Subject Matter Experts Draw Conclusions – and they must understand the photographic process

Forensic Photographic Comparisons Historical Highlights (1/2)

- FBI Conducted since 1960's (and earlier…)
  - JFK Assassination
    - Rifle in backyard photos to recovered weapon (WC)
    - Photo to camera comparisons (WC)
    - SA Shaneyfelt testified that he had conducted "100 to 300 photographic examinations" prior to JFK case (WC)
    - Facial comparisons of Oswald (HSCA)
  - Bank Protection Act of 1968
    - Camera in banks – source of evidentiary photos
    - Greater need for photo-examiners in FBI

Forensic Photographic Comparisons Historical Highlights (2/2)

- Case law dating from the 1970's to today demonstrates court acceptance of photographic comparison testimony.
  - Daubert challenges met and passed in this decade.
- Most publications in law enforcement journals, conference proceedings, forensic journals, or as chapters in books addressing broader areas.
  - Many "case studies".
  - "THE TEXTBOOK" does not yet exist.

Some Labs Where Photographic Comparisons are Performed

- FBI – Forensic Audio, Video and Image Analysis Unit
- U.S. Army Criminal Investigation Laboratory
- Wisconsin State Crime Laboratory in Wausau
- The Centre of Forensic Sciences (Ontario)
- Royal Canadian Mounted Police (RCMP)
- Netherlands Forensic Institute (NFI)
- Target Corporation

Forensic Photographic Comparisons

- Technique – ACE-V model (like latent prints)
  - Image acquisition (film, video, digital still)
  - Image processing (enhance images)
    - ≠ Photographic Comparison by itself!
  - Image Analysis/observation (note features)
  - Comparison (correspondence of features?)
  - Evaluation (meaning of correspondence/lack)
    - Sometimes can be supported by statistics (not required)
  - Verification

- ACE is the scientific method

Forensic Photographic Comparisons Examples

- Facial Comparisons/Human ID from Images
- Vehicle Identification/Comparisons
- Clothing Comparisons
- Camera Identification

Applying Statistics to Patterned Clothing Characteristics

- One seam – 1/30 chance of specific alignment (1/30 more conservative than 1/36)
- Two seams – 1/30 * 1/30 = 1/900
- Three seams – 1/30 * 1/30 * 1/30 = 1/27,000
  - (More than number manufactured…identification)
  - 4 seams – 1/810,000
  - 5 seams - 1/24,300,000
- In one robbery, saw 11 seams/pieces…
  - (1/30)^11 = 1/1.77 E+16 (17,714,700,000,000,000)

Camera Identification/Individualization

- Questioned images all exhibited same defective pixels (15 total identified).
- Total number of pixels in image 2048 x 1536 = 3,145,728 (3.1 million).
- Chance of two images having same single bad pixel at random ~ 1 in 3.1 million squared (~ 1 in 10 to the 12^{th} power).
- 15 pixels? - < 1 in 10 to the 50^{th} power.
- = Same camera.

Forensic Photographic Comparisons Limitations

- Why is the field more prominent today?
  - Increase in image and video evidence in society (and need for law enforcement analysis)
    - Surveillance video (public and private sector)
    - Digital Cameras (including cell phones)
    - Internet (including webcams)
  - Increase in ability of law enforcement agencies to process digital images and video
    - Increase in computer power/reduction in cost makes equipment much cheaper (FBI not only ones who can afford equipment)
- BUT PROCESSING ≠ COMPARISON

Forensic Photographic Comparisons What is needed?

- Infrastructure
  - Full time personnel, dedicated to this field
  - Peer review – Opinion based conclusions demand it
- Education
  - Image Science
    - Anyone can “look” at a picture – one needs to be trained to “analyze”
  - Comparison Analysis
    - What characteristics are most meaningful?
  - Statistics and statistical modeling

Forensic Photographic Comparisons What is needed?

- Education in Statistics
  - Can’t have statistical tables for everything.
    - Photo comparisons may involve ANYTHING.
  - Models often developed on a case-by-case basis
- Research
  - Statistics of Facial Minutiae (including ear patterns)
  - Biometrics (black box) vs. Forensic Science (why does a technology work)

Forensic Photographic Comparison Analysis Questions?

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