SWGDE Best Practices for Image Content Analysis

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Scientific Working Group on Digital Evidence

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1. Purpose

The purpose of this document is to provide personnel with guidance regarding practices appropriate when performing photographic content analysis as a part of forensic image analysis. For the purposes of this document, photographic content analysis refers to the drawing of conclusions about an image or the subjects/objects represented in the image.

2. Scope

For the purposes of this document, the word "image" refers to an imitation or representation of subject or object derived from still photography or video.

This document provides basic information and best practices on the evidentiary value, methodology, conclusions, and limitations when conducting photographic content analysis as a part of any forensic analysis. The intended audience is image analysis examiners in a lab setting. Due to the variety of subjects/objects potentially represented in an image or video, this document includes but is not limited to all methods encountered in forensic photographic content analysis.

This document is not intended to be used as a step-by-step guide for conducting a proper forensic examination or reaching a conclusion. This document should not be construed as legal advice.

3. Definitions

Content Analysis
> The process of drawing conclusions about an image. Targets for content analysis include, but are not limited to, the subjects/objects within an image; the conditions under which, or the process by which, the image was captured or created; the physical aspects of the scene (e.g., lighting or composition); and/or the origin of the image.

Physical Object
> A thing or person to which action is directed

Class Characteristic
> A feature of an object that is common to a group of objects

Individualizing Characteristic
> A feature of an object that contributes to differentiating that object from others of its class

4. Limitations

This document will not describe discipline-specific analytical techniques outside of image analysis or the limitations associated with them, only the process for performing image content analysis and the general manner used to formulate a conclusion.

This document is not intended to be a training manual or a specific operating procedure. Examiners performing image content analysis should have sufficient training and experience in image science to allow the formation of a conclusion. For further information, refer to *SWGDE Training Guidelines for Image Analysis, Video Analysis, and Photography*.

This document is not all-inclusive, and does not contain information related to specific products.

This document should not be construed as legal advice.

5. Evidence Preparation

General guidelines concerning the preparation of evidence for content analysis are provided as follows:

5.1 Review the request for examination to determine the subject matter of the content analysis.

5.2 Based on the request for examination, determine if submitted imagery is available to complete requested analysis. Determine whether submitted imagery is of sufficient quality to complete the requested examination, or if the image quality will have an effect on the degree to which an examination can be completed.

    5.2.1 If the specified quality criteria are not met, determine if it is possible to obtain additional images. If the specified quality criteria are not met, and additional images cannot be obtained, this may preclude the examiner from conducting an examination, or the results of the examination may be limited.

5.3 Identify the specific portion(s) of the image(s) that are the subject of the analysis.

5.4 Enhance images as necessary. Refer to SWGDE *Image Processing Guidelines*.

6. Examinations Method

There is no one specific methodology for content analysis. The methodology for analysis will primarily be derived to answer the requested examination. However, any methodology applied to content analysis should incorporate an analysis of the imagery, the cataloguing of relevant features, an evaluation of the significance of the detected features, an evaluation of the limiting factors of the imagery, the formation of a conclusion, and a verification of the analysis. The repeatability of the procedure and documentation of the workflow is of paramount importance. Documentation should be performed contemporaneously.

6.1 Assess the contents of the image, to determine whether factors are present that can answer the examination request. The examination request generally will fall into one of the following categories:

    6.1.1 Analysis to determine the conditions under which, or the process by which, the image was captured or created. Examples include, but are not limited to, the limitations of the recording device, and the inclusion of artifacts based on the file format or compression. This can help to answer the question "How does the recording system affect what is visible in the scene?"

    6.1.2 Analysis to determine the physical aspects of the scene, including events captured. Examples include, but are not limited to, the lighting and composition of the scene, the presence of specific objects within the scene, a determination of the interaction between objects in the scene, and a description of events within a

scene. This can help to answer the questions "Is a specific object visible in the scene?" or "What happened in the scene?"

    6.1.3 Analysis to determine the classification of an object within an image. Examples include, but are not limited to, the make, model, and year of a vehicle, the determination of a manufacturing logo, and the determination of the brand and model of a weapon. This can help to answer the question "What is the object visible in the scene?"

    6.1.4 Analysis to determine the location or setting of the image content. Examples may include either a general setting (e.g. Portland, Oregon) or a specific setting (e.g. Conference Room 23, the Northwest Corner). This can help answer the question "Where is the scene?"

6.2   Assess the image for features that hinder the ability to form a conclusion. This may involve physical obstructions (e.g. a face mask on an individual), recording system limitations (e.g. subject to camera distance or resolution of the recording system), or digital artifacts (e.g. image information obscured by macroblocking).

6.3   Assess the image for features that contribute to the ability to form a conclusion, and record observed features. Consider the weight or importance of identified features, in order to determine the focus of the examination. Examples of features may include logos, shapes, reflections, or specific items.

6.4   Identify any resources that may assist in the formulation of the conclusion. Examples of resources include, but are not limited to:

    6.4.1 Training and experience

    6.4.2 Internet

    6.4.3 Other laboratories

    6.4.4 Academia

    6.4.5 Manufacturing facilities (site visit) and resources

    6.4.6 User manuals, periodicals, books, journals, court records

7.   Conclusions

Based on the observations and assessments, a conclusion should be reached.

7.1   Assess the significance of each of the identified features based on the research performed. This can include determining the weight a specific feature may have, and/or assigning it to a class or individualized category.

7.2   Based on the observed features and any research performed, form a conclusion to address the requested analysis. Conclusions must be properly qualified and address the limitations of the methodology and research.

7.3 In the cases where an appropriate statistical basis for a conclusion exists, the level of finding should reflect the probability. The underlying assumptions, particularly simplifying assumptions, for the statistical model should be reported along with details of the population statistics.

7.4 If no appropriate statistical model is available, a clear indication of the strength of a conclusion should be reported. This will necessarily be a descriptive statement and not a numerical probability. Care should be taken to avoid implying probability where none exists.

7.4.1 Examiners should define the observations (or features) that correspond to given levels of conclusion, and report what the characteristics were that support the specified conclusion.

7.5 The results of the examination should undergo independent review by a comparably trained individual. If disputes during review arise, a means for resolution of issues should be in place.

8. Limitations of Methodology

The strength of conclusions will be limited by the quality of the imagery, the availability of discerning features, and the availability of reference material. Based on these factors, it is possible the requested examination cannot be fulfilled. Examiners should take care not to overstate conclusions, and to verify reference materials through cross-referencing multiple sources when possible.

One potential source of uncertainty in any forensic analysis results from bias. It is the responsibility of the organization and the examiner to minimize the effects of bias when conducting examination and performing reviews. Minimizing the effects of bias can be accomplished through awareness, training, documentation (of any potential sources for bias and the steps taken to minimize) and quality assurance measures including the limitation of task irrelevant information and blind verification.

Appendix A. Work Flow Examples

Example 1 – "Vehicle Make/Model/Year" Example

A local police department receives a report of a bank robbery and then responds to the bank to retrieve the evidence. After retrieval, a compact disc containing video is turned over to a forensic laboratory to determine the make, model, and year of the get-away vehicle.

Following the methodology described above, the laboratory proceeds:

1. The request is reviewed and it is:
   a. determined that this type of analysis is performed,
   b. determined that all necessary items to support the requested exam have been submitted,
   c. determined that the laboratory has the necessary equipment, materials, and resources needed to conduct the requested analysis, and
   d. assigned to an analyst.
2. The analyst acquires the necessary imagery.
   a. The analyst calls the investigating agency and determines that copies of the original video have been received.
   b. The practitioner reviews the video and selects relevant images for further analysis.
3. The analyst makes copies of the selected imagery for use as working copies, and safely stores the received video.
4. Image processing techniques such as brightness and contrast adjustments, unsharp masking, and multi-pixel averaging may be performed. The use of these techniques is documented per the unit's SOP.
5. The analyst identifies features to classify the questioned vehicle by make, model, and year. The analyst notes details specific to the vehicle including but not limited to the shape of the vehicle, the shape of the windows, the shape of the grill, the license plate position, and the presence and position of trim. The analyst notes that due to a lack of detail, the license plate and the logo cannot be resolved.
6. The analyst accounts for compression artifacts and the effect they may have on the image.
7. The analyst identifies known vehicle resources, including resources available to the public on the internet.
8. Based on the highest weighted features, including the shape of the grill and the license plate position, the analyst determines that the questioned vehicle is most consistent with a specific make and model over a defined year range.
9. A comparably trained individual in the laboratory independently reviews the results of the examination.

10. The analyst writes the report. Per the laboratory's SOPs, the report includes a review of the materials received, the request, the methods used, the results obtained, the basis for the conclusion, and the conclusion.

Example 2 – "Where was this photograph taken?" Example

A local police department receives a report of possible child exploitation and downloads imagery from the internet. After retrieval, a compact disc containing images is turned over to a forensic laboratory to determine the physical location of the subject based on background information that may be present in the scene.

Following the methodology described above, the laboratory proceeds:

1. The request is reviewed and it is:
    a. determined that this type of analysis is performed,
    b. determined that all necessary items to support the requested exam have been submitted,
    c. determined that the laboratory has the necessary equipment, materials, and resources needed to conduct the requested analysis, and
    d. assigned to an analyst.
2. The analyst acquires the necessary imagery.
    a. The analyst calls the investigating agency and determines that the best quality images have been received.
    b. The practitioner reviews the images and selects relevant images for further analysis.
3. The analyst makes copies of the selected imagery for use as working copies, and safely stores the received disc.
4. Image processing techniques such as brightness and contrast adjustments, unsharp masking, and multi-pixel averaging may be performed. The use of these techniques is documented per the unit's SOP.
5. The analyst identifies features to classify the questioned location. The analyst notes details specific to the scene including, but not limited to: the local flora, location specific buildings, any signage that is present, language on the signage, license plate coloration, the environmental conditions, the date of capture recorded in the meta data, the GPS information in the meta data, and dated periodicals.
6. The analyst examines the image for indications of tampering. The analyst also accounts for compression artifacts and the effect they may have on the image.
7. The analyst researches resources available to the public on the internet to classify characteristics identified in step 5. The analyst also consults with academics to classify the noted flora in the scene.

8. Based on the observed features, the analyst determines that the questioned scene is most consistent with a location.
9. A comparably trained individual in the laboratory independently reviews the results of the examination.
10. The analyst writes the report. Per the laboratory's SOPs, the report includes a review of the materials received, the request, the methods used, the results obtained, the basis for the conclusion, and the conclusion.

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History

Revision	Issue Date	Section	History
1.0 DRAFT	2016-09-15	All	Initial draft created and SWGDE voted to release as a Draft for Public Comment.
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