OSAC 2022-S-0031 Standard Guide for Forensic Digital Video Examination Workflow

Video/Imaging Technology and Analysis Subcommittee
Digital/Multimedia Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science

Draft OSAC Proposed Standard

OSAC 2022-S-0031 Standard Guide for Forensic Digital Video Examination Workflow

Prepared by
Video/Imaging Technology and Analysis Subcommittee
Version: 1.0
August 2022

Disclaimer:

This OSAC Proposed Standard was written by the Organization of Scientific Area Committees (OSAC) for Forensic Science following a process that includes an open comment period. This Proposed Standard will be submitted to a standards developing organization and is subject to change.

There may be references in an OSAC Proposed Standard to other publications under development by OSAC. The information in the Proposed Standard, and underlying concepts and methodologies, may be used by the forensic-science community before the completion of such companion publications.

Any identification of commercial equipment, instruments, or materials in the Proposed Standard is not a recommendation or endorsement by the U.S. Government and does not imply that the equipment, instruments, or materials are necessarily the best available for the purpose.

To be placed on the OSAC Registry, certain types of standards first must be reviewed by a Scientific and Technical Review Panel (STRP). The STRP process is vital to OSAC's mission of generating and recognizing scientifically sound standards for producing and interpreting forensic science results. The STRP shall provide critical and knowledgeable reviews of draft standards or of proposed revisions of standards previously published by standards developing organizations (SDOs) to ensure that the published methods that practitioners employ are scientifically valid, and the resulting claims are trustworthy.

The STRP panel will consist of an independent and diverse panel, including subject matter experts, human factors scientists, quality assurance personnel, and legal experts, which will be tasked with evaluating the proposed standard based on a comprehensive list of science-based criteria.

For more information about this important process, please visit our website at: https://www.nist.gov/topics/organization-scientific-area-committees-forensic-science/scientific-technical-review-panels.

Standard Guide for Forensic Digital Video Examination Workflow

1. Scope

1.1. This guide provides a generalized workflow suitable for all digital video examinations performed to address forensic questions[1].

1.2. This workflow includes the assessment, processing, and analysis of video. Prior steps such as the retrieval and proper handling of the evidence are assumed. Refer to ASTM WK61709, Standard Practice for Data Retrieval Digital Video Recording Systems and SWGDE Best Practices for Digital Forensic Video Analysis for additional information.

1.3. This standard is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice E2917), and demonstrated proficiency to perform forensic casework.

1.4. This guide does not purport to address safety concerns. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.5. No system units are required for this standard guide.

2. Referenced Documents

2.1. *ASTM Standards*:

2.1.1. E860, Standard Practice for Examining And Preparing Items That Are Or May Become Involved In Criminal or Civil Litigation, ASTM International, West Conshohocken, PA, 2013, www.astm.org

2.1.2. E2825, Standard Guide for Forensic Digital Image Processing, ASTM International, West Conshohocken, PA, 2019, www.astm.org

2.1.3. E2916, Standard Terminology for Digital and Multimedia Evidence Examination, ASTM International, West Conshohocken, PA, 2019, www.astm.org

[1] OSAC Technical Series 0002R1 A Framework for Harmonizing Forensic Science Practices and Digital/Multimedia Evidence details these questions are addressed using a specific and finite number of core forensic processes labeled as 1) authentication, 2) identification, 3) classification, 4) reconstruction, and 5) evaluation.

2.1.4. E2917, Standard Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs, ASTM International, West Conshohocken, PA 2019, www.astm.org

2.1.5. ASTM WK61709, Standard Practice for Data Retrieval Digital Video Recording Systems, www.astm.org

2.1.6. ASTM WK66417, Standard Guide for Training Guidelines for Video Analysis, Image Analysis and Photography, https://www.astm.org/DATABASE.CART/WORKITEMS/WK66417.htm

2.2. SWGDE Material:

2.2.1. SWGDE Best Practices for Digital Forensic Video Analysis Version: 1.0 (November 20, 2018, v1.0)

2.2.2. SWGDE Technical Overview of Digital Video Files Version 1.0 (July 18, 2017)

2.2.3. SWGDE Best Practices for Forensic Audio

2.2.4. SWGDE Best Practices for Image Content Analysis

2.2.5. SWGDE Fundamentals of H.264 Coded Video for Examiners

2.2.6. SWGDE Best Practice for Photographic Comparison for All Disciplines

2.4 *OSAC Material:*

2.4.2 OSAC 2021-S-0037, Standard Guide for Photogrammetry

2.4.3 OSAC 2021-S-0036, Standard Guide for Image Authentication

OSAC 2022-S-0001 Standard Guide for Image Comparison Conclusions/Opinions

2.4.4 OSAC Lexicon [https://lexicon.forensicosac.org/]

2.4.5 Preferred Terms

3. Terminology

3.1. *Definitions:*

3.1.1. For definitions of terms used in this guide, refer to Terminology E2916, OSAC Preferred Terms or the OSAC Lexicon.

4. Summary

4.1. The digital video examination workflow includes the following three domains: assessment, processing, and analysis. The general workflow and procedures used in each domain may be the same regardless of the evidence submitted by the requestor.

4.2. Assessment tasks involve the review of the submitted items for suitability for examination, determination of the region(s) of interest, and the preparation of a working copy to be used during examination.

4.3. Processing tasks involve the production of deliverable output products or intermediate products to be used for examination.

4.4. Analysis tasks involve the interpretation of information extracted from the submitted items to answer the questions posed in the requested examination.

5. Significance and Use

5.1. The workflow and task domains presented in this document create a consistent framework upon which forensic video service providers can structure their services, division of duties, and operating procedures.

5.2. A given examination may not require the performance of tasks from all of the domains described.

5.3. Depending on one's training, an individual forensic science practitioner could be authorized to perform tasks from one or more of these domains.

6. Assessment Domain of Forensic Digital Video Examination Workflow

6.1. Actions performed during the assessment of video evidence are the foundational steps necessary before implementing the Processing or Analysis workflows, or both, which are listed later in this guide. The assessment workflow is as follows:

6.1.1. Review the request to determine that it is technically feasible, that it can be accomplished by the forensic service provider, and that the required resources are available.

6.1.2. A *working copy* of the *evidence* shall be created and verified through a *hashing function*.

6.1.3. An initial technical review of the video file should be performed and any issues should be documented (e.g., *aspect ratio* problems, inconsistent playback speed, required proprietary player).

6.1.3.1. Interrogation of the video file(s) should be performed to determine display attributes relevant to processing and analysis such as display resolution, pixel aspect ratio, frame rate, and *codec*.

6.1.3.2. A comparison of file interrogation results from multiple tools or manual parsing and decoding of a file's binary data is recommended. Technical observations about the video and any discrepancies in the reported results should be documented and evaluated.

6.1.4. If the video is not viewable, obtain the proprietary video player, codec, or additional required equipment.

6.1.5. If it becomes apparent during the assessment that an earlier generation of the recording may exist (e.g., through file metadata, indication of a conversion process), contact the requestor.

6.1.5.1. If the original or best quality recording is not provided, document that fact and inform the requestor of any limitations imposed on the examination.

6.1.6. Discrepancies between the observations of the submitted video and the details provided should be documented by the forensic science practitioner and, if possible, reviewed with the requestor.

6.1.7. Additional details and documentation that may assist in the assessment of the video should be requested. For example, documentation on the initial recovery of digital video evidence may provide additional information such as the recording device's time offset and device settings.

6.1.8. Assessing areas or regions of interest can be based on both temporal and spatial information. When confirming the area of interest for processing and analysis, the following should be considered:

6.1.8.1. There may be relevant information contained within the video outside the requested area of interest (e.g., clocks, signs, potential witnesses, bystanders). The relevance of such information can be determined by the requestor and the forensic science practitioner.

6.1.8.2. Document relevant information observed during the assessment and, if possible, review observations with the requestor that may have an impact on the examinations.

6.1.9. Any audio present in the video should be reviewed to obtain relevant additional details.

6.1.9.1. Audio may require an additional examination by a trained audio examiner. See SWGDE Best Practices for Forensic Audio for recommendations on a forensic audio workflow.

7. Processing Domain of Forensic Digital Video Examination Workflow

7.1. Actions performed while processing video include procedures to transform input media to output media. For example, processing includes tasks to *transcode*, *enhance*, *restore*, *carve* video data, and perform *timeline sequence reconstruction*. These actions could lead to tasks performed in the Analysis Domain of this workflow.

7.1.1. Software vendors may not share the same names for processes or filters within their applications.

7.2. If the submitted video cannot be processed in its original format, it may be necessary to produce a converted file via transcoding or screen capturing video. Steps to preserve the original video should be taken regardless of the technique used.

7.2.1. See SWGDE's Technical Overview of Digital Video Files for additional information on the foundation of knowledge of file formats, encoding standards, and compression algorithms used in digital video.

7.3. Transcoding is the *conversion* of multimedia from one format or encoding method to another. This includes decoding, demultiplexing, exporting still images and video, and screen capturing of still images and video.

7.3.1. Transcoding is intended to change only the encoding form, not the content of the data. However, the results of certain processes, such as compression, can affect the content. Video resulting from transcoding should fairly and accurately represent the visual contents of the original video.

7.3.1.1. The output of different transcoding types and the use of different playback systems may need to be compared to determine which will provide the best representation of the original video.

7.3.2. Discrepancies between the input video and output video shall be documented.

7.3.3. The preferred techniques for transcoding are:

7.3.3.1. Transferring original bitstream data into a new container. This technique, commonly known as re-wrapping, preserves the video bitstream but might remove or alter some metadata contained in the original video container. For

example, creation times or frame timing information may be changed as a result of the transcoding process. Containers might interact differently with various video data and not all containers will support all media codecs.

7.3.3.2. Carving video bitstream data. Video data carving is the extraction of a video bitstream from a larger data structure. For additional details, See SWGDE Fundamentals of H.264 Coded Video for Examiners.

7.3.3.3. Converting the video file. This technique would change the video stream into an uncompressed or lossless video format.

7.3.4. Transcoding to lossy formats:

7.3.4.1. If the video is to be used for further analysis, transcoding to a lossy format is only acceptable if a preferred transcoding technique is not available and the result provides an accurate representation of the original content.

7.3.4.2. Distribution products used for review and not for analysis may use a lossy format if it provides accurate representation of the original content.

7.3.4.3. The reason for the use of a lossy format should be documented. For example, a lossy format would be acceptable if a proprietary player is the only option and will only export in a lossy format.

7.3.5. Some proprietary video players may provide an option to save in a different format than the original video. If none of the preferred transcoding techniques are available, choose the transcoding option that best preserves the quality of the original video. For example, sequential still images in a lossless format may be exported and used to produce a video.

7.3.5.1. Verify and document any visible differences or degradation from what was displayed in the proprietary video player.

7.3.6. Screen capturing may be used if it provides the best quality output.

7.3.6.1. When screen capturing video, settings should be chosen to prevent dropped frames.

7.4. Additional processing techniques such as *Enhancement* and *Restoration*, are used to maximize the visibility of details in digital video or still images.

7.4.1. Guide E2825 outlines some image enhancement techniques that can be used for video, such as brightness adjustments, color processing, contrast adjustment, and

cropping. Guide E2825 also includes linear filtering techniques such as sharpening, blur removal, edge enhancement, and deconvolution.

7.5. Guide E2825 outlines image restoration techniques that can also be used for video, such as blur removal, color balancing, grayscale linearization, and geometric restoration.

7.6. Additional techniques commonly used in video processing which are not included in Guide E2825 include:

7.6.1. Adjusting the orientation of video content.

7.6.2. Adjusting the frame rate of video so as to affect the playback speed.

7.6.3. Stabilizing techniques to position individual frames to a specific area of interest that will remain in a set location as the video is played.

7.6.4. Techniques to *deinterlace* frames of video that are interlaced such as aligning fields or adjusting ratios.

7.6.5. Deblocking techniques to reduce the artifacts caused by block-based compression algorithms.

7.6.6. Signal adjustments such as applying a spatial frequency-based to reduce pattern noise.

7.6.7. Techniques for adjusting video display attributes such as scale and aspect ratio using interpolation.

7.7. Avoid the introduction of artifacts that can add misleading information to the file or the loss of detail such as clipped pixels or ringing artifacts.

7.8. Timeline Sequence Reconstruction involves relating still images and video to each other and other relevant data to develop a chronological sequence of events relevant to the examination.

7.8.1. Analysis as described in Section 8 may be required to determine the relevant information.

7.9. Enhancement and restoration techniques shall be documented in a manner to permit a comparably trained forensic science practitioner to understand the steps taken, the techniques used, and to extract comparable information from the processed file.

8. Analysis Domain of Forensic Digital Video Examination Workflow

8.1. The analysis domain includes the application of specific subject matter expertise to interpret data from video evidence and draw opinions[2] regarding the question of interest.

8.1.1. Refer to the OSAC 2022-S-0001 Standard Guide for Image Comparison Conclusions/Opinions for additional details regarding opinion categories that may be reached by a forensic practitioner performing comparisons of people, objectives, or scenes captured in images (e.g., face, vehicle clothing, skin detail), regardless of the process by which opinions are reached.

8.2. Categories of video analysis: Authentication, *Photogrammetric Analysis*, Content Analysis, and Comparative Analysis.

8.2.1. Authentication, the process of substantiating that the data is an accurate representation of what it is purported to be. Refer to OSAC 2021-S-0036, Standard Guide for Image Authentication.

8.2.2. Photogrammetric analysis, the process of obtaining dimensional information regarding objects and people depicted in video. Refer "SWGDE Best Practices for the Forensic Use of Photogrammetry" for specific methodologies.

8.2.3. Content Analysis, forming results and interpretations about a video. Targets for content analysis include, but are not limited to, the subjects/objects within a video; the conditions under which, or the process by which, the video was captured or created; the physical aspects of the scene, such as lighting or composition, or the provenance of the video. Refer to SWGDE Best Practices for Image Content Analysis.

8.2.4. Comparative Analysis, the assessment of the correspondence between features in still images and known objects or images for the purpose of rendering an opinion regarding identification, elimination, or a qualified conclusion. Refer to OSAC 2022-S-0001 Standard Guide for Image Comparison Conclusions/Opinion and SWGDE Best Practice for Photographic Comparison for All Disciplines.

[2] There is a movement in the forensic community to eliminate the word “conclusion” from the formal set of words that describe forensic processes. For example, ISO does not use the word “conclusion”. This is reflected by the Organization of Scientific Area Committees for Forensic Science (OSAC) preference to use the term “opinion” (defined as View, judgment, belief – takes into consideration other information in addition to observations, data, calculations, and interpretations).

9. Keywords

9.1. Video Analysis

9.2. Video Examination

9.3. Video Assessment

9.4. Video Processing

9.5. Video Transcoding

9.6. Image Restoration

9.7. Video Restoration

9.8. Image Enhancement

9.9. Video Enhancement

9.10. Multimedia Evidence

9.11. Forensic Video

9.12. Forensic Science

9.13. Timeline Sequence Reconstruction