SWGDE Considerations for the Use of Time-Based Analysis of Digital Video for Court

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Table of Contents

1. Purpose

There are several factors that can affect the display of digital video. Those relying on this evidence within the legal process must be aware of these factors in order to assure the correct use and understanding of video playback and presentation in relation to speed. The purpose of this document is to provide basic considerations for the use of time-based analysis of digital video files in court.

2. Scope

This document provides basic concepts for understanding frame timing video analysis in investigative or legal settings which may include assessment of speed, duration, or timing. The intended audience for this document is anyone attempting to provide or utilize such analyses, including but not limited to judges, prosecutors, criminal defense attorneys, civil attorneys, video analysts, forensic engineers, detectives, and traffic investigators.

3. Limitations

This is not a technical document. Due to the wide variety of proprietary digital video recording devices and file formats, a singular approach to assessing frame rate and timing cannot be applied to all files. For technical information, see *SWGDE Core Technical Concepts for Frame Timing Analysis of Digital Video Files*. For specific technical information regarding H.264 video, see *SWGDE Best Practice for Frame Timing Analysis of H.264 Video Stored in ISO Base Media File Formats*.

4. Introduction

Time based analysis can provide a fundamental and useful explanation of time, space, and movement in digital video files. Time based analysis or frame timing analysis refers to the number, duration, and timing of individual frames within a digital video stream. Due to the variations in encoding methods, the number, duration, and timing of frames within a digital stream can vary greatly depending on the playback method used. For example, if a tool that reads video metadata reports a frame rate of 15 frames per second, those frames may not appear at consistent intervals within any given second within the video stream. In addition, the amount of time any individual frame is displayed may also vary depending on the playback software and/or video codec utilized. Applications of time-based analysis of video include speed assessment in collision investigations, use of force inquiries, self-defense claims, and slip and fall civil lawsuits.

While attempting to determine speed and/or distance, analysts must account for factors that affect the analysis and avoid applying calculations that are too general for the task, which can result in inaccurate or incomplete results. For example, speed determination utilizing only the equation speed = total distance/elapsed video time may not accurately reflect movement in video.

5. Major Factors Affecting Time-Based Analysis

When performing time-based analysis, the following factors should be considered:

5.1 Source

The source of the digital video should be known and verified. Playback timing may be affected when digital files are converted. Absent an original video file, the effects of conversion to a different video file format for playback may not be readily apparent to the user.

5.2 Frame Rate

Although 30 frames per second is considered "real-time" for single camera video streams, video from CCTV and other evidence sources may not be recorded or displayed in "real-time." The analysis must be performed based on the original frame timing or movement will not display at the correct speed.

Additionally, video sources may record at a variable frame rate that is dependent on the amount of motion in a designated area. For example, a motion based digital video security system may be set to record a video signal at 5 frames per second when no motion is detected, but the frame rate may change to 15 frames per second when the system detects motion in the camera's view.

5.3 Media Playback Software

Media playback software can have an effect on both playback timing and viewable information. For example, a file that plays back at one speed in the system manufacturer's native player may play at a different speed in another video player, depending on the player's interpretation or use of the internal timing information. The user should be aware that even the manufacturer's player may not play back at the correct speed. Further, one player may show date, time, and frame identification information, while another player may not.

5.4 Transcoding

Transcoding refers to the modification of video files from their original format in order to allow for ease of playback in a variety of video players. When video files are transcoded, the frame rate may be changed. While the visual display of the video file (pixel values) may not change, metadata stored within the file container that stores information about the file will change.

5.5 Dropped frames

Transcoding, screen capture, and data transfer processes may result in the loss of frames, which will affect calculations and timeline sequence reconstruction.

5.6 Variable Speed

Recording devices may record an unequal number of images during equal intervals of time. This may be despite user settings. For example, a system set to record 10 frames per second may record four images per second during one second, 10 images per second the following second, and 12 images per second during the following second. The user must be aware of the effects of variable speed recording on time-based analysis.

5.7 Video from Multiple Sources

When video files from multiple sources are combined, any timing differences should be accounted for and explained. For example, timeline sequences may contain clips from multiple sources, each having its own frame rate.

6. Other Considerations

In addition to the aforementioned factors that can affect the elapsed time between frames of video, a number of factors can affect the appearance of distance recorded video. Camera angle, field of view, lens distortion, object distance to the camera, and lighting considerations can all make objects appear to move faster or slower. Additionally, aspect ratio (height to width of an image) may affect the appearance of object speed. Care should be taken to ensure that video files are displayed at the correct aspect ratio as it is common for many proprietary file formats to display incorrectly.

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History

Revision	Issue Date	Section	History
1.0 DRAFT	2019-09-19	All	Initial draft created and voted by SWGDE for release as a Draft for Public Comment.
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