Audio-Video Forensic Analyst - (AVFA)

Competency Requirements

This Competency listing serves to identify the major knowledge, skills, and standards areas in which a certified Audio-Video Forensic Analyst will be required to know in order to perform the professional tasks associated with evaluating, authenticating, and enhancing analog & digital media using digital electronic technology. A certified Audio-Video Forensics Analyst must be capable of recovering and repairing analog/digital data while maintaining the integrity of all original recordings.

An Audio-Video Forensic Analyst must be knowledgeable in the following technical areas:

1.0 General Understanding of Audio and Video File Structure and Compression

- 1.1 Audio Fundamentals
  - 1.1.1 Identify fundamental audio terms with respect to human speech
    - 1.1.1.1 Explain the differences between sound hertz (Hz) and decibels (dB)
    - 1.1.1.2 Identify human hearing versus speech in hertz
  - 1.1.2 Explain the following audio terms:
    - 1.1.2.1 Headroom
    - 1.1.2.2 Dynamic Range (DR)
    - 1.1.2.3 Signal-to-Noise Ratio (SNR)
    - 1.1.2.4 Audio distortion
    - 1.1.2.5 Clipping
    - 1.1.2.6 Pitch
    - 1.1.2.7 Amplitude
    - 1.1.2.8 Audio attenuation
    - 1.1.2.9 Notch
    - 1.1.2.10 Comb
    - 1.1.2.11 Reverberation
    - 1.1.2.12 High pass/Low pass Filter
- 1.2 Describe the use and effects of audio compression
- 1.3 Video Fundamentals
  - 1.3.1 Explain aspect ratio in detail
    - 1.3.1.1 Differentiate between Widescreen Aspect (16:9) and Standard Aspect (4:3) ratio
  - 1.3.2 Explain the following in detail:
    - 1.3.2.1 Luminance
    - 1.3.2.2 Chrominance
    - 1.3.2.3 RGB color model - (red, green, blue)
    - 1.3.2.4 YUV color encoding system - (luminance and chrominance)
  - 1.3.3 Describe how changes in frame rates can affect frame accuracy
  - 1.3.4 Explain progressive scanning or non-interlaced scanning in detail
  - 1.3.5 Explain the following terminology in detail:
    - 1.3.5.1 The Master
    - 1.3.5.2 Histogram
    - 1.3.5.3 Freeze Frame
    - 1.3.5.4 Dub
  - 1.3.6 Explain video techniques such as:
    - 1.3.6.1 Pan
    - 1.3.6.2 Tilt
    - 1.3.6.3 Roll
  - 1.3.7 Differentiate between the following video transitions:
    - 1.3.7.1 Fades
    - 1.3.7.2 Wipes
  - 1.3.8 Digital Video Fundamentals
    - 1.3.8.1 Explain pixels in depth
      - 1.3.8.1.1 Explain pixilation
      - 1.3.8.1.2 Describe pixel blocks

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- 1.3.9 Describe resolution of an image
  - 1.3.9.1 Explain the relationship of aspect ratio to resolution
- 1.3.10 Describe Transcoding and its effects:
  - 1.3.10.1 video transcoding
  - 1.3.10.2 audio transcoding
- 1.3.11 Describe compression and decompression technology
- 1.3.12 Differentiate between a field and a frame

2.0 Metadata and Header Structure of Digital Audio and Video Files

- 2.1 Explain Audio Formats including:
  - 2.1.1 AIFF (audio interchange file format)
  - 2.1.2 MP3 (MPEG-1 or MPEG-2 Audio Layer III®)
  - 2.1.3 WAV (Waveform Audio File Format)
  - 2.1.4 WMA (Windows Media® audio)
  - 2.1.5 AAC (Augmentative and Alternative Communication)
  - 2.1.6 AMR (Adaptive Multi-Rate)
  - 2.1.7 Ogg Vorbis
  - 2.1.8 FLAC/ALAC (Free Lossless Audio Codec)/(Apple Lossless Audio Codec)
  - 2.1.9 PCM (Pulse Code Modulation)
- 2.2 Digital Video Formats
  - 2.2.1 Explain ‘Codec’ and how it works
  - 2.2.2 Differentiate between a video file container and a codec
  - 2.2.3 Describe codec’s effect on digital video
- 2.3 Describe the basic video formats including:
  - 2.3.1 Digital Video (DV) tape
  - 2.3.2 Audio Video Interleave (AVI) - (.avi)
  - 2.3.3 Advanced Systems Format (ASF) - (.asf)
  - 2.3.4 Advanced Stream Redirector (ASX)
  - 2.3.5 Windows Media Video - (.wmv)
  - 2.3.6 QuickTime© - (.mov or .qt)
  - 2.3.7 Advanced Video Coding, High Definition (AVCHD)
  - 2.3.8 Flash Video - (.flv)
  - 2.3.9 Shockwave Flash® - (.swf)
  - 2.3.10 Moving Picture Experts Group (MPEG) – 4 (.M4V, MP4)
  - 2.3.11 MPEG Transport Stream - (.mts)
  - 2.3.12 Material Exchange Format - (.mxf)
  - 2.3.13 WebM (.webm)
  - 2.3.14 Matroska Video files - (.mkv)
- 2.4 Differentiate between streaming media versus progressive downloads
  - 2.4.1 Explain video streaming and how it is accomplished
  - 2.4.2 Explain progressive downloads and how they are accomplished
- 2.5 Explain video compression formats including:
  - 2.5.1 MPEG 1- 4
  - 2.5.2 CBR (constant bit rate)
  - 2.5.3 VBR (variable bit rate)
  - 2.5.4 HEVC (high efficiency video coding)
- 2.6 Explain image compression and discrete cosine transform (DCT)
- 2.7 Explain still image format types including:
  - 2.7.1 BMP (bitmap image file)
  - 2.7.2 GIF (graphics interchange format)
  - 2.7.3 JPEG (joint photographic experts group)
    - 2.7.3.1 Quantization table
    - 2.7.3.2 Photo Response Non-Uniformity (PRNU)-based camera identification
  - 2.7.4 PICT (Apple graphic file format)
  - 2.7.5 TIFF (tagged image file format)
  - 2.7.6 PNG (portable network graphics)
- 2.8 Explain date-time Metadata including:
  - 2.8.1 Encoded Date
  - 2.8.2 Tagged Date

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- 2.8.3 Date Created
- 2.8.4 Date Modified
- 2.8.5 Date Accessed
- 2.8.6 UTC (coordinated universal time)

2.9 Explain GPS data and its conversion to a street address

2.10 Explain frame rate data including:

- 2.10.1 minimal frame rate
- 2.10.2 maximum frame rate

2.11 Describe what a Hex reader is and how to use it

3.0 Authentication and Application of Tamper Detection with Digital Audio and Video Files

3.1 Audio editing

- 3.1.1 Explain basic audio editing terminology
- 3.1.2 Differentiate between Amplify and Attenuate
- 3.1.3 Describe an audio waveform
  - 3.1.3.1 Explain how audio waveforms are generated and measured
- 3.1.4 Explain the differences between the following recording plugins:
  - 3.1.4.1 Equalizer
  - 3.1.4.2 Reverb
  - 3.1.4.3 Compressor versus Expander
  - 3.1.4.4 Limiter versus Gate
- 3.1.5 Describe Electrical Network Frequency (ENF)
  - 3.1.5.1 Explain how ENF is used in audio authentication
- 3.1.6 Explain how post-production audio edits can result in:
  - 3.1.6.1 subsonic anomalies
  - 3.1.6.2 shift in DC bias
  - 3.1.6.3 inconsistencies in an otherwise cyclical frequency pattern
  - 3.1.6.4 changes in the noise profile
  - 3.1.6.5 changes in the waveform pattern of angularity
- 3.1.7 Explain how post-production video edits can result in:
  - 3.1.7.1 quantization errors
  - 3.1.7.2 ghost compression
  - 3.1.7.3 overlapping macroblocks
  - 3.1.7.4 non-identical duplicate frames
  - 3.1.7.5 odd resolution values

3.2 Video editing

- 3.2.1 Define the term ‘Raw Cut’
  - 3.2.1.1 Explain how to use a Raw Cut
- 3.2.2 Explain the differences between a scene and a clip
- 3.2.3 Define the term ‘Channel’
  - 3.2.3.1 Describe how a Channel is used
- 3.2.4 Explain a Timeline in depth
- 3.2.5 Explain a Track in depth
- 3.2.6 Define and describe the following video editing terminology:
  - 3.2.6.1 Time ruler
  - 3.2.6.2 Edit line
  - 3.2.6.3 Jog
  - 3.2.6.4 Shuttle
  - 3.2.6.5 Preview
  - 3.2.6.6 Real-time preview
  - 3.2.6.7 Preview File
  - 3.2.6.8 Scrub
  - 3.2.6.9 Call-out
  - 3.2.6.10 Render
  - 3.2.6.11 Render Scrub
  - 3.2.6.12 Export
  - 3.2.6.13 Scratch disk
- 3.2.7 Explain basic User Interface Terminology in relation to video editing
- 3.2.8 Explain the use of a Butterworth filter

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- 3.2.8.1 Define a maximally flat magnitude filter
- 3.2.9 Explain Import and Capture in relation to video editing
- 3.2.10 Explain in depth editing of clips and tracks
- 3.2.11 Explain basic Titles and Credits relating to video editing
- 3.2.12 Explain Transitions and Effects in relation to video editing
- 3.2.13 Describe different types of color spaces used by analysts including:
  - 3.2.13.1 YV12
  - 3.2.13.2 RGB
  - 3.2.13.3 RGBa
  - 3.2.13.4 HSV (HSL, HSB)
  - 3.2.13.5 L*a*b*
  - 3.2.13.6 Pseudo color

4.0 Enhancement Methodologies of Digital Audio and Video Files

- 4.1 Explain audio enhancement processes
  - 4.1.1 Describe critical listening techniques
  - 4.1.2 Speakers versus Headphones
  - 4.1.3 Dereverberation
- 4.2 Describe noise reduction methods including:
  - 4.2.1 Spectral Subtraction
    - 4.2.1.1 Audio Spectral Subtraction
    - 4.2.1.2 Boll Spectral Subtraction
  - 4.2.2 Fast Fourier Transform (FFT)
  - 4.2.3 Discrete Cosine Transform (DCT)
- 4.3 Explain the effect of subtracting a Gaussian blur

5.0 Audio Forensic Fundamentals

- 5.1 Identify a subsonic audio spike in an audio recording
- 5.2 Identify effective methods to reduce distracting single tones from an audio recording
- 5.3 Identify the general order of audio enhancement processes for recovering speech

6.0 Video-Image Forensic Fundamentals

- 6.1 Identify Video cropping evidence
  - 6.1.1 Explain applying Image Error Level Analysis (ELA) to an image
  - 6.1.2 Explain applying Video Error Level Analysis (VELA) to a video
- 6.2 Describe video blowout
- 6.3 Identify the order of applying video enhancement filters to provide the clearest results (acuity) from a surveillance video
  - 6.3.1 Explain Photogrammetry
  - 6.3.2 Explain Videogrammetry
- 6.4 Explain Steganography
- 6.5 Define a Temporal Filter
- 6.6 Explain “salt and pepper” transitory visual defects

7.0 Industry Requirement, Best Practices, Report Writing, and Relevant Federal Code

- 7.1 Identify the procedures of the rules of evidence
- 7.2 Summarize the use of HASH values and/or chain-of-custody control to maintain data integrity
- 7.3 Identify the difference between a Frye challenge and Daubert challenge
- 7.4 Identify expectations for all interested parties within the scope of the project
  - 7.4.1 Explain the different types of budget constraints to interested parties including:
    - 7.4.1.1 software needs
    - 7.4.1.2 new hardware requirements for current project
    - 7.4.1.3 transmissions costs for a given video quality
    - 7.4.1.4 time requirements
  - 7.4.2 Identify project completion processes involved concerning:
    - 7.4.2.1 steps in the process
    - 7.4.2.2 progress reporting milestones

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7.5 Identify professionalism and communication qualities needed throughout the life of a digital video project
7.6 Identify the importance of ethics in this field, especially in the age of Artificial Intelligence (ex. Lyrebird)
7.7 Identify key components of a Technical Report
- 7.7.1 Identify technical qualifications an AVFA possesses
- 7.7.2 Explain how research findings and data are assembled
- 7.7.3 Identify why the term "KISS (Keep It Simple Stupid)" is important for non-technical people to understand the research
- 7.7.4 Explain the importance of keeping information in a logical order
- 7.7.5 Identify to audience why the report information is valuable
- 7.7.6 Explain why it is important to ensure all data is relevant
- 7.7.7 Identify how report information can be utilized

End of Certified Audio-Video Forensic Analyst Competency

Find An ETA Test Site: https://www.etai.org/test_sites.html

Suggested Additional Resource and Study Material:

http://www.videocleaner.com/
https://www.asisonline.org/
https://www.asprs.org/divisions/photogrammetric-applications-division-2/forensic-working-group
https://www.acfe.com/
http://forensicprotection.com/Education_Forensic_Analyst.html
http://forensicworkinggroup.com/MAT.pdf
https://www.loc.gov/preservation/digital/formats/fdd/fdd000117.shtml
http://www.primeauforensics.com/audio-forensics/15-a-step-by-step-approach-to-forensic-audio-enhancement/
https://imagingforensics.com/about/

Digital Video Editing Fundamentals; Wallace Jackson; ISBN 978-1484218655; Apress Media; Apr 14, 2016

Upgrading and Repairing Networks, 5th Ed.; Scott Mueller, Terry Ogletree, Mark Soper; ISBN 978-0789735300; Que Publishing; 2006

Cut by Cut: Editing Your Film or Video, 2nd Ed.; Gael Chandler; ISBN 978-1615930906; Michael Wise Productions; 2012

O*NET online: https://www.onetonline.org/link/summary/27-4032.00 and its related page: https://www.bls.gov/OOH/media-and-communication/film-and-video-editors-and-camera-operators.htm

ASTM E2916-19e1 ***Standard Terminology for Digital and Multimedia Evidence Examination***
Guidance on Non-routine Offsite Forensic Examination of Digital/Multimedia Evidence

Summary of the Rules of Evidence:
https://corporate.findlaw.com/litigation-disputes/summary-of-the-rules-of-evidence.html

Daubert Versus Frye: A National Look at Expert Evidentiary Standards:
https://www.theexpertinstitute.com/daubert-versus-frye-a-national-look-at-expert-evidentiary-standards/

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