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

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

- 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

- 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
  - 3.2.13.5 LAB

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
- 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: http://www.eta-i.org/testing.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/

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

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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ETA certification programs are accredited through the ICAC, complying with the ISO/IEC 17024 standard.

