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### AUTHENTICATION OF SOUND RECORDINGS FOR EVIDENTIARY PURPOSES

An ever-increasing reliance on tape evidence in both criminal and civil hearings underscores the importance of tape integrity and the methods used to qualify or disqualify audiotape evidence. Tape recordings are subject to increasing falsification and misinterpretation, especially with the advent of computer-based digital editing equipment. The purpose of this paper is four-fold: 1) to identify the predominant methods by which audio tapes are normally intentionally altered or falsified; 2) identify the physical and instrumental techniques for detecting signs of tape falsification; 3) briefly discuss the increasing threat caused by modern-day digital editing techniques and 4) provide examples of both analog and digitally falsified tapes.

There are two generally accepted approaches for establishing the authenticity of a questioned tape recording. Current legal practices normally require that the burden of proof be placed on the attorney seeking to introduce the tape into evidence. This will require that the attorney demonstrate that certain accepted methods designed to protect from any form of tape tampering have been adhered to and if that is not successful to submit the tape to a qualified expert for a forensic examination. On a more practical level, an original recording is considered authentic if it starts at the beginning of the tape and does not stop until the end. Any stops or restarts should be announced by the operator. Original recordings should contain all of the audio information recorded at the moment in time that the event occurred. The recording should further not contain any break in its continuity or content nor should it contain any suspicious signs suggestive of falsification.

It is important for both attorney and investigator to understand that falsification or tampering with tapes involves an intentional attempt to alter the tape's original content. Often, however, the evidential recorders and their respective tapes have been unintentionally interrupted during the recording process. This innocuous or accidental interruption of the tape does not constitute a falsification effort and may include the

following operator errors; 1) accidental stop/restart of tape recorder; 2) mechanical malfunction of the tape recorder; 3) damage to the tape oxide or the use of a previously recorded tape; 4) “off-speed” recording due to low batteries or improper AC line connections; 5) microphone abnormalities; etc.

The major categories of intentional tape editing or falsification include; 1) Deletion; 2) Obscuration; 3) Transformation; and 4) Synthesis. Deletion of unwanted material can be rapidly accomplished through either splicing or by using one or more recorders to erase, rerecord, or stop/pause the recorder at strategic points within the conversation. Obscuration involves the distortion of a recorded signal with the purpose of rendering selective portions unintelligible (i.e. the eighteen minute gap in the infamous Watergate tapes). This technique can also be used to mask splices, clicks, or suspicious transients. Transformation involves the alteration of portions of a recording so as to alter its original content. The technique is similar to deletion practices but requires greater knowledge of acoustic phonetics and is more difficult to accomplish. Lastly, Synthesis is the generation of artificial text by adding background sounds or conversation to the taped copy which were not present on the original recording. It should be emphasized that all of the aforementioned traditional analog techniques for altering audiotapes could be more effectively and surreptitiously accomplished through the use of digital editing workstations.

The principles of falsification are also similar to the general principles of disguise. Namely, the individual actually effecting the tape falsification is attempting to obscure or disrupt important features of the originally recorded event or subject of interest. This is accomplished through various masking techniques. Secondly, falsification efforts are often designed to misdirect the attention of the listener to an irrelevant aspect or feature of the signal or an event of interest.

The electromechanical indications of falsified tapes should include one or more of the following phenomenon:

- 1) Gaps - Segments in a recording which represents unexplained changes in content or context. A gap can contain buzzing, hum, or silence.
- 2) Transients - short, abrupt sounds exemplified by clicks, pops, etc. Transients may indicate tape splicing or some other interruption of the recording process.
- 3) Fades - gradual loss of volume. Fades can cause inaudibility and are considered gaps when the recording becomes fully inaudible.
- 4) Equipment sounds - inconsistencies of context caused by the recording equipment itself. Common equipment sounds include hum, static, whistles, and varying pitches.
- 5) Extraneous voices - background voices which at times appear to be as near as the primary voices, and at times can even block the primary voices.

The methods for detecting falsified (non-authentic) recordings include:

Critical Listening - the forensic tape specialist will normally listen with high quality head phones and professional recording equipment to the original tapes prior to conducting any instrumental examination. He notes any unusual aural and/or acoustic events such as starts, stops, speed fluctuations, and other variations requiring investigation. He examines all recorded events to include both foreground and background sounds and listens for abnormal changes, absences, or presences of differing environmental sounds. He concentrates on voices, conversation and other audible sounds.

Aural Anomalies - would include sudden changes in a person's voice, abrupt unexplained topic changes, or a sudden change in foreground/background information.

Physical Inspection - Includes a thorough review of the tape recording to include the cassette or micro-cassette housing. He inspects the housing for pry marks, or any inconsistent data relative to the manufacture of the tape. He further may inspect splices to insure that they appear to have been made through a normal manufacturing process and looks for any other irregularities in the total length of the tape or its composition.

Magnetic Development - Accomplished through the application of a special fluid which under proper magnification will make visible the head track configuration of the original recorder, off-azimuth recordings, start/stop functions, damage to recording heads, etc. This process is extremely important in the individualization of the original recorder used to produce the questioned tape.

Spectrum Analysis - Employs the use of specialized computer equipment which measures the frequency spectrum of the recorded tape and provides a visual interpretation of the frequency vs. amplitude, frequency vs. amplitude vs. time displays. This allows for the expert to view the entire spectrum or to zoom in on one particular area of interest to help characterize the acoustic nature of a particular anomaly and to possibly identify its source.

Waveform Analysis - A computer generated display representing time vs amplitude of recorded signals in graphic form. Such analysis normally allows the expert to measure and identify record-mode events including the measurement of record-to-erase-head distances, determination of the spacing between gaps and multiple gap erase-heads, and inspection of the signature shape and spacing of various record event signals.

Test Recordings on Evidential Recorders and Accessory Equipment -Various electrical, magnetic and mechanical measurements of both standard and modified recorders can be used in determining the possible origins of questionable tones or sounds occurring on the evidential recording.

There exist many different methods of both analog and digital editing of tape recordings and the below examples highlight one of the more common methods utilized.

## TRADITIONAL METHODS

### OF TAPE EDITING

1. Whispered Speech
2. Vocal Disguise or
3. Typical Analog Edits - Splicing
4. Rerecording to obscure physical physical edits, etc.

### METHOD OF DETECTION

1. Talker identification (voice print analysis) involving the combined aural/spectrographic method.
2. Talker identification (voice print analysis) Mimicking
3. Critical listening, instrumental analysis, magnetic development, and spectrum analysis. (electronic or physical), stop/restart, over-recording, pausing of recorder, erasures, dubbing, etc.
4. Critical listening, instrumental analysis, magnetic development, and spectrum analysis.

## CONTEMPORARY/FUTURE CHALLENGES

Digital Editing of both audio and video tapes has greatly complicated the authentication process and increases the likelihood that altered tapes can escape detection. There are at least 30 different desktop computer editing workstations or digital recorders which can be used as "turnkey" editing systems. Software and add on computer cards can transform an IBM or Macintosh computer into a sophisticated digital audio editing machine. Some of the systems require a digital audio recorder for initial conversion of the analog format before accessing the computer hardware. These editing workstations were originally designed by the motion picture and recording industries to correct subtle errors in multi-track releases and can now be purchased at prices as low as \$300 for the software. The editing options are practically inexhaustible and provide the operator the ability to alter the tape in a word-processing format ie. cut and paste, copy, delete, etc., while selecting playback files which can help "shape" the sound. The typical telltale signs of traditional analog recorder editing including clicks and pops and other short duration sounds can now be effectively removed without little if any detectable audible clues.

Examples of varying editing processes including related hardware and/or equipment:

- 1) Pitch Shift Telephones
- 2) Vocal Disguise through synthesized speech (Votrax or Dectalk).
- 3) Computer Manipulation of speech formant data (Kay Elemetrics Model 4300 and ASL programs - Re-synthesis of Human Speech)
- 4) Additive mixing of noise or other background and foreground signals into on going speech.
- 5) Signal Processing Filters (analog and digital)
  - a. Phasing Anomalies
  - b. Chorusing
  - c. Harmonic Distortion

- d. Reverberation
- e. Filtering of Selective Frequencies
- f. Channel Switching

The threat of future digital editing is becoming of increasing concern to the courts. It is therefore more imperative than ever that both the original tapes and the recorders be made available for inspection. Both the FBI Signal Analysis Branch and other certified acoustic tape experts recognize that it is essential for the contributing attorney to provide all of the original tapes and related recording equipment before a complete authentication can be accomplished.

Professor Chial and I have attempted to explain some of the more traditional and more recent methods of detecting falsified or edited audio tape recordings; identify the various physical and instrumental techniques for detecting signs of tape falsification; discuss various examples of falsified tapes, and lastly to briefly discuss the increasing threat Caused by digital computer-based editing systems. It is relatively easy to change the content of a recording by deleting words or obscuring meaning with over-recorded sounds or by transforming the context through rearrangement of selected phrases or added words. Nevertheless, falsifications normally leave detectable magnetic and waveform acoustic signatures which can lead to forensic individualization of the evidential recorders and tapes.

Note: For additional information see the following published articles:

“Authentication of Forensic Audio Recordings,” Journal of Audio Engineering Society, 38, 1990, Bruce E. Koenig.

The National Commission for the Review of Federal and State Wire Tapping Laws, 1976, Mark Weiss, et al.

“Verifying the Integrity of Audio and Video Tapes,” The Champion Magazine, Summer 1993, Steve Cain.

“Sound Recordings as Evidence in Court Proceedings,” article submitted and tentatively accepted by The Prosecutor Magazine, in late 1994, Steve Cain.