



Introduction to Audio Forensics

8th MyCERT SIG

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Agenda

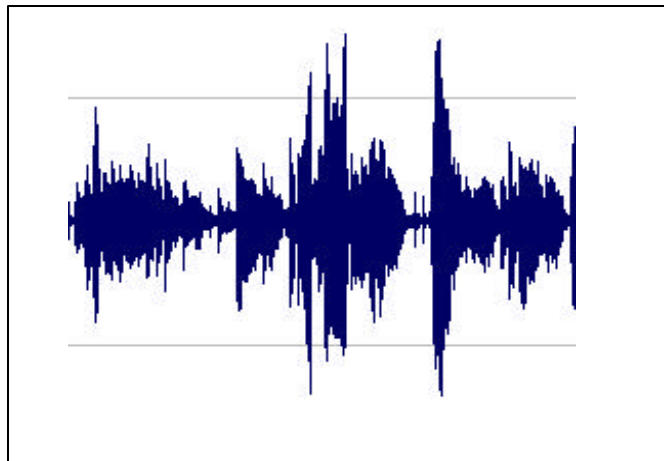
- Audio forensics definition
- Audio forensics origin
- Technologies and methodologies of audio forensics
- Audio enhancement demonstration

Audio forensics introduction

- Definition of **forensics**
 - “The use of science and technology to investigate and establish facts in criminal or civil courts of law” – <http://www.dictionary.com>
- Definition of **audio forensics**
 - Can be defined as “The application of audio science and technology to investigate and establish facts in criminal or civil courts of law”.

Audio forensics origin

- Spectrograph was developed by Bell Telephone laboratory. Acoustic scientist use it during World War II to identify enemy voices on telephones and radios.



*Time-Frequency-Amplitude (TFA) Spectrograph

- The technology keeps growing and more powerful techniques have figured.

Technologies and methodologies of audio forensics

- Specialty areas:
 - Voice identification
 - Audibility analysis
 - Enhancement
 - Listenability enhancement
 - Intelligence enhancement

Technologies and methodologies of audio forensics

- Authenticity analysis
- Sound identification
- Event sequence analysis
- Dialogue decoding
- Other signal analysis

Voice identification

- Comparison of a known voice to an unknown voice to determine the identity of the unknown voice.
- Every voice has its own phonetic characteristics.
- Involve T-F-A spectrographic and machine/computer analysis of the audio signals.

Voice identification

- The analysis consists of the comparison of similarities and differences of elements of speech such as bandwidths, fundamental frequency, prosody, vowel formant trajectory, occlusive, plosives, fricatives, pitch striations, formant energy, breath patterns, nasal resonance, coupling, and any special speech pathology of the speaker.
- Voice identification evidence remains controversial and faces passionate opposition in courts of law.

Audibility analysis

- Reconstruction of an acoustic event to determine if the event could be heard by a person of normal hearing ability or by subject in question
 - Could the event be heard?
 - Was it obscured by a masking signals?

Enhancement: Listenability enhancement

- Applying equalization, compression, amplitude increase and limiting to make it more listenable.



Original

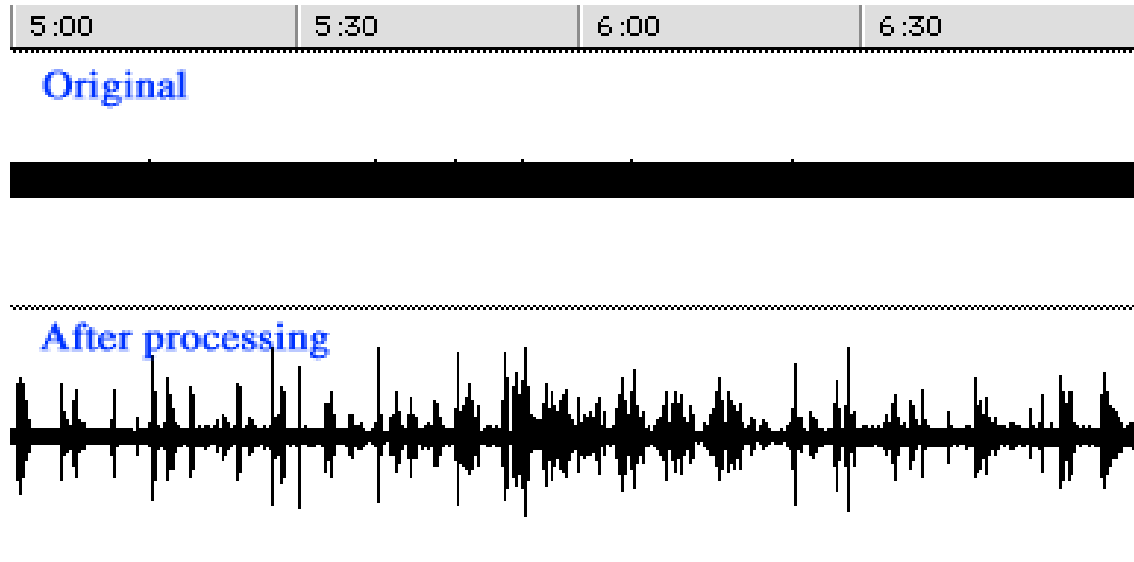


After processing

Enhancement: Intelligibility enhancement

- More complex and demands engineering task.
- Involves spectrographic analysis, complex deconvolution filtering, wideband and multiband compression, amplitude increase and limiting.

Enhancement: Intelligibility enhancement



- Sometimes the process reveals unknown audio events.

Authenticity analysis

- Determine the simultaneous origins with the acoustic event represented
- Verify the authenticity of a suspicious recording through physical inspection, aural analysis, frequency, energy, amplitude and formant structure analysis, magnified visual inspection and photographic documentation of results.

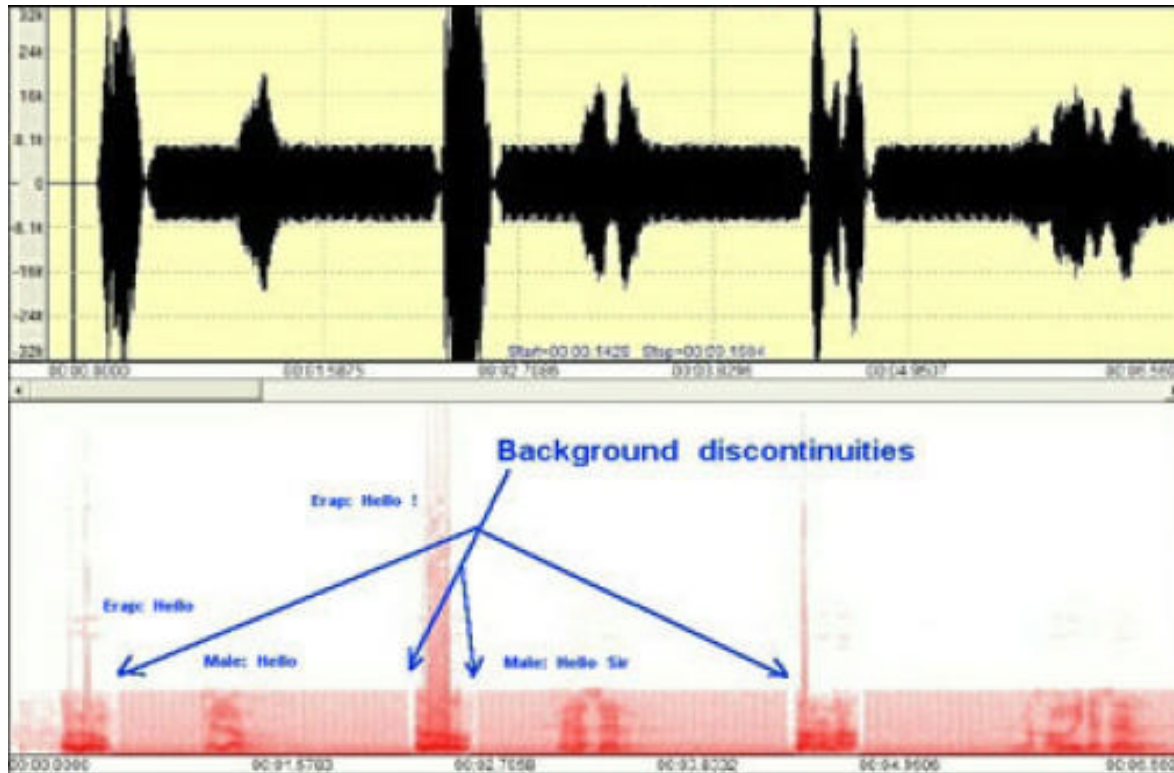
Sound identification

- Comparison of a known sound to an unknown sound to determine the identity of the unknown sound
- Sometime it was not a barely audible sound but an acoustic illusion caused by a recording device or an extraneous source

Event sequence analysis

- Analysis of the sequence of acoustic events to determine the critical components such as timing, frequency and amplitude of a recording

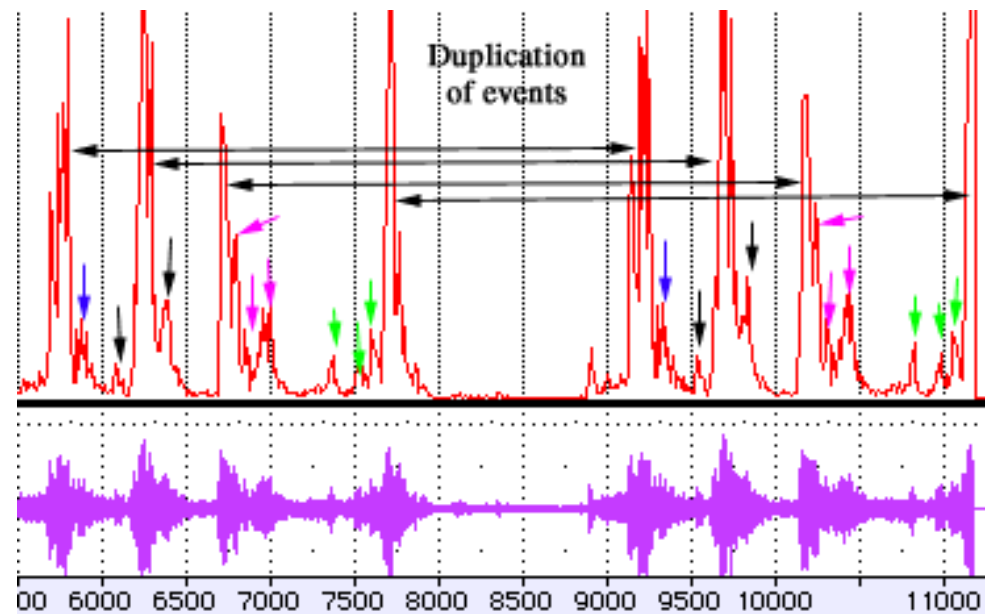
Event sequence analysis



- To verify the authenticity of a recording

Dialogue decoding

- Determine what has been said in a recording based on the voice pattern in a spectrograph.



Dialogue decoding

- However it is not within the realm of audio forensics but it is more towards the realm of a speech scientist.

Other signal analysis

- Evaluation of 'other' sonic events inside a recording that is extraneous to the investigation.
- It may reveal important information such as background conversation, machine rhythms, engine frequency, reverberation or even gunshot.

Questions?





Thank you for listening.

THE END