

## Forensic Analysis and Enhancement of Digital Audio

**Course Description:** This course covers practical fundamentals in digital audio theory, forensic audio handling, and enhancement. Specifically, hands-on practice will include: digital evidence tools that can aid in the recovery of digital audio, spectral tools for forensic analysis including the FFT spectrum and spectrogram, and specific filters for noise reduction and stereo source separation. Students will create their own recordings for group problem solving and discussion.

### **Course Outcomes:**

#### KNOWLEDGE

Students will:

- Gain new perspectives to understand:
  - General principles of forensic science.
  - Basic principles of forensic media.
  - Evidence admissibility.
  - Proper evidence handling and analysis methodology.
  - Digital evidence seizure and acquisition.
  - General principles of acoustic and audio phenomena.
  - Sound digitization and digital audio recordings.
  - Foundations of noise reduction and sources separation.
  - Limitations of the forensic expert.
- Acquire knowledge that either enhances or is not covered in scientific literature.

#### SKILLS

Students will:

- Take entrance and exit exams to gauge course's effectiveness while informing student regarding the advancement of their knowledge.
- Understand the questions that they shall be able to answer as a forensic expert.
- Work with digital evidence.
- Apply signal processing in order to enhance audio evidence.
- Demonstrate a familiarity with general topics related to forensic audio.

#### DISPOSITIONS

Students will:

- Gain an appreciation for specific issues in forensic audio.
- Be able to critically evaluate different forensic audio equipment, software, and methods.
- Enhance awareness of needs and opportunities in the field of forensic audio.

## **Course Schedule:**

1. Introduction to Media Forensics
  - 1.1. Forensics and Media Forensics Principles
  - 1.2. Admissibility of Audio Evidence
2. Foundations in Audio Engineering
  - 2.1. Sound and Acoustics
  - 2.2. Audio Recording Flow
  - 2.3. Sound Digitization
  - 2.4. Digital Signal Processing
3. Forensic Audio Enhancement
  - 3.1. Analysis of the Sound Spectrum
    - 3.1.1. FFT Spectrum and Spectrogram
    - 3.1.2. Speech and Noise Analysis
  - 3.2. Noise Reduction
    - 3.2.1. Digital Filters
    - 3.2.2. Adaptive Filters
    - 3.2.3. Spectral Subtraction and Source Separation
  - 3.3. Enhancement Practice
  - 3.4. Case Notes and Documentation
4. Digital Media and Evidence Recovery
  - 4.1. Bit-Stream Imaging
5. Written and Practical Examination
  - 5.1. Digital Evidence Seizure and Acquisition
  - 5.2. Preparation of Enhanced Material