University of Colorado Denver

National Center for Media Forensics
College of Arts & Media

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Advanced Forensic Audio Enhancement (AE2)

Course Description: This course builds on knowledge and skills gained in the longstanding *Forensic Analysis and Enhancement of Digital Audio* course, by exploring deeply the processing of digital multimedia and advanced techniques for enhancing recorded audio through filtering, noise reduction, and cross-channel adaptive filtering. Additional time will be spent on working with audio files from video and batch processing with free command line utilities such as FFmpeg.

Previous completion of <u>one</u> of the following courses is **required**:
  – *Forensic Analysis and Enhancement of Digital Audio*
  – *Fundamentals of Forensic Audio Enhancement*

Previous experience/formal training with digital evidence is recommended.

*Please note that some of the methods and software discussed and presented may only be available for demonstration purposes and/or to law enforcement agencies.

Course Outcomes:

KNOWLEDGE
Students will:
- Gain new perspectives to understand:
    - The latest forensic audio recording/processing techniques.
    - Advanced principles of forensic audio enhancement.
    - Forensic techniques, emerging science, and limitations of the forensic expert.
    - Digital evidence seizure and acquisition.
- Acquire knowledge which either enhances or is not covered in scientific literature.

SKILLS
Students will:
- Apply audio processing for increased intelligibility using advanced filters.
- Use FFmpeg, SoX, and other free command line utilities for processing large amounts of audio in batch.
- Know how to apply advanced techniques for forensic audio enhancement.
- Understand the questions that they shall be able to answer as a forensic expert.
- Take entrance and exit exams to gauge course's effectiveness while informing student regarding the advancement of their knowledge.
- Demonstrate a familiarity with general topics related to forensic audio.

Students will:
- Gain an appreciation for advanced 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. Fundamentals of Forensic Audio Enhancement Review
   1.1. Digital Recording Techniques
   1.2. Noise Reduction
   1.3. Sources Separation
2. Demonstration and Practice
   2.1. Advanced Forensic Audio Enhancement
   2.2. Noise Reduction
   2.3. Sources Separation
   2.4. Machine Learning Techniques
3. Introduction to Command Line
   3.1. FFmpeg
   3.2. SoX
4. Batch Processing
   4.1. Batch Scripting
   4.2. Batch Processing with Audio Software
5. Hands-On Lab
   5.1. Recording
   5.2. Processing
   5.3. Production of Final Product