EE-719

Digital Speech and Audio Coding

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Cursus	Sem.	Type
Electrical Engineering		Opt.

Language of teaching	English
Credits	4
Session	
Exam	Multiple
Workload	120h
Hours	**56**
Courses	30
Exercises	14
TP	12
Number of positions	

Frequency

Every 2 years

Remark

Next time: Fall 2026

Summary

The goal of this course is to introduce the engineering students state-of-the-art speech and audio coding techniques with an emphasis on the integration of knowledge about sound production and auditory perception through signal processing techniques.

Content

1. Introduction
Human speech production, Music production, Auditory perception, Brief overview on information theory and coding theory.
2. Applied Signal Processing
Brief overview on sampling and quantization, Discrete Fourier transform, Perfect reconstruction, Quadrature mirror filter, Modified discrete cosine transform, Stereo processing, Linear prediction (LP), Auditory filters, Auditory masking, Perceptual auditory models (Johnston's model, MPEG models), Spectral band replication, Temporal noise shaping.
3. Speech Coding
Scalar and Vector quantization, Lossless coding, Waveform and parametric coding, Vocoders, LP coders, Analysis by Synthesis and Code excited LP codec, Adaptive multi-rate (AMR).
4. Audio Coding and Emerging Trends
Perceptual audio coders, MPEG-1, MPEG-2, MPEG-4, Dolby AC, Sony, AMR-WB, Generic coding.
5. Evaluation and Standardization of Audio and Speech coders
Objective evaluation techniques (PESQ, PEAQ), Subjective evaluation techniques (MOS, MUSHRA, BS.1116), Standardization (ITU).
6. Laboratory Exercises
Auditory perception models, Auditory filters, Estimation of masking threshold, Simple perceptual waveform coder, Objective quality evaluation techniques.

Keywords

Speech coding, Audio coding, Speech and music production, Auditory perception.

Learning Prerequisites

Recommended courses

Undergraduate level signal processing, programming in Matlab or similar.

Learning Outcomes

By the end of the course, the student must be able to:

- Formulate
- Analyze
- Contextualise
- Contrast
- Exploit
- Explain

Teaching methods

Lectures, Hands-on lab exercises, Open discussions

Expected student activities

Attend lectures, read literature, carry out lab exercises, question-answering, make presentations on selected topics

Assessment methods

Multiple.

Resources

Moodle Link

- https://go.epfl.ch/EE-719