ECHO-AWARE signal processing for audio scene analysis

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Introduction

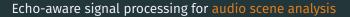


Image animation here

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Scenario

Sound recorded by microphones carries

- Semantic information about source nature and content
- Temporal information
 - Spatial information about due to sound propagation

Audio Scene Analysis

- extraction and organization of all the information in the sound
- typical problems
 - Sound Source Separation
 - Speech Enhancement
 - Sound Source Localization
 - Room Geometry Estimation

- · Acoustic Measurements
- · Speaker Diarization
- · Automatic Speech Recognition
- · etc.

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Signal Processing

Microphone recordings x_i and sound sources s_j are (digital) signals

$$x_i(t) = (h_{ij} * s_j)(t)$$

It is the role of mathematics and computer science

General Pipeline

- Models
- · Representation
- Estimation
- Adaptive Processing

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Acoustic Echoes

- · Product of the sound propagation
- Sound repetition
 - · "same" content: can be integrated
 - · "different" sounds: carry info about the reflection
 - · different direction of arrival: spatial information

Compromise

Between the full simplification and the full model

Thesis objective

- provide new methodologies and data to process and estimate acoustic echoes
- 2. extend previous classical methods for audio scene analysis

1D Outline

Echo-aware signal processing for audio scene analysis

Introduction
Motivation
Outline
Modeling
From Physics to Digital Signal Processing
The Echo Model
Acoustic Echo Estimation
Literature Review
blaster
lantern

interim conclusion Echo-aware Application

2D Outline

Projects

Modeling

$Physics \longrightarrow Signal\ Processing$

Sound propagates and Green equation aoeu

Acoustic Reflection

aoeu

Room Impulse Response aoeu

Signal Processing → Digital Signal Processing

Signal model in time domain

aoeu

Signal model in the discrete time domain aoeu

Signal model in the frequency domain aoeu

Approximations

The Echo Model

Time Domain aoeu

Frequency Domain

aoeu

Approximations

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Interim Conclusion I

Approximations Echoes are off-grid by nature Sampling and quantization make them hard

Acoustic Echo Estimation

Taxonomy and Approaches

Image of taxonomy

Toxonomy

aoeu

Existing Approaches

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AER as Discrete SIMO BCE

Limitation and Bottleneck

Proposed Approach

Results

Echo-aware Application