

# ECHO-AWARE signal processing for audio scene analysis

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November 6, 2020

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## Introduction

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Image animation here

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.*

## 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

## 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

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

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

Projects



## Modeling

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Sound propagates and Green equation

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Acoustic Reflection

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Room Impulse Response

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Signal model in time domain

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Signal model in the discrete time domain

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Signal model in the frequency domain

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Approximations

Time Domain

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Frequency Domain

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Approximations

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### Approximations

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

## Acoustic Echo Estimation

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Image of taxonomy

Toxonomy

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Existing Approaches

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## Echo-aware Application

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