

# ECHO-AWARE signal processing for audio scene analysis

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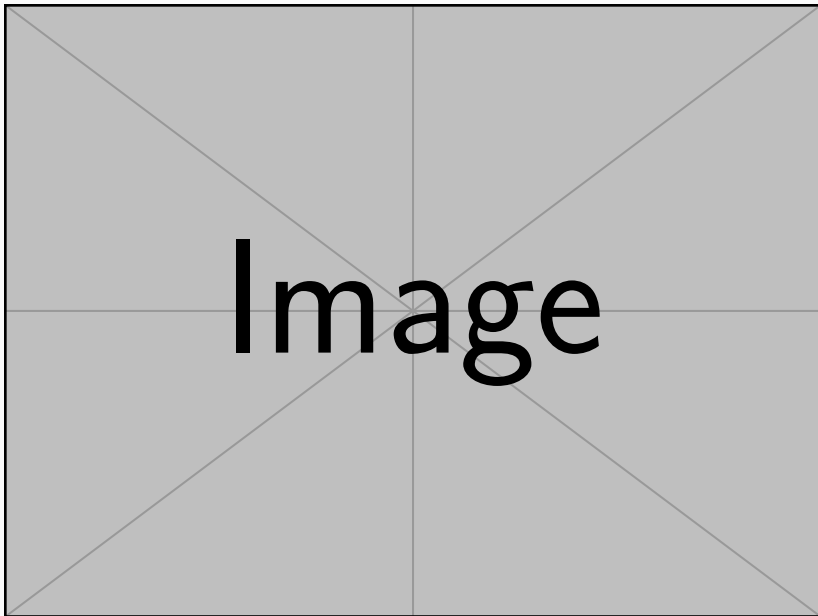
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## Introduction

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# Echo-aware signal processing for **audio scene analysis**

Sound recorded by microphones carries information:

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



## **Audio Scene Analysis**

is the extraction and organization of all the information in the sound



## Typical problems

- What?
  - *Sound Source Separation*
  - *Speech Enhancement*
  - *Automatic Speech Recognition*
  - ...
- Where?
  - *Sound Source Localization*
  - *Room Geometry Estimation*
- When?
  - *Speaker Diarization*
  - *Text/Lyrics alignment*
- How?
  - *Acoustic Channel Estimation*
  - *Acoustic Measurements*

Also known as auditory scene analysis or computer auditory scene analysis.

Inverse and Forward problems

Blind and Informed problems

Everything is connected

## Signal Processing

Offer mathematical models, frameworks and tools to tackle such ASA problems

### 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

## Turning echoes into friends

Typically reverberation is considered as “foe” for the processing.

## 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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