AES Milan 2018 - Audio Re-purposing using Sound Separation

Sound Source Separation: An Introduction

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Outline

1. Definition of Sound Source Separation (SSS)
2. Methods for SSS
   - Models of the source position
   - Models of the source
   - Models for interference reduction
3. Applications
   - Examples
4. Evaluation of SSS algorithms

1. What is Sound Source Separation?

- A Definition -

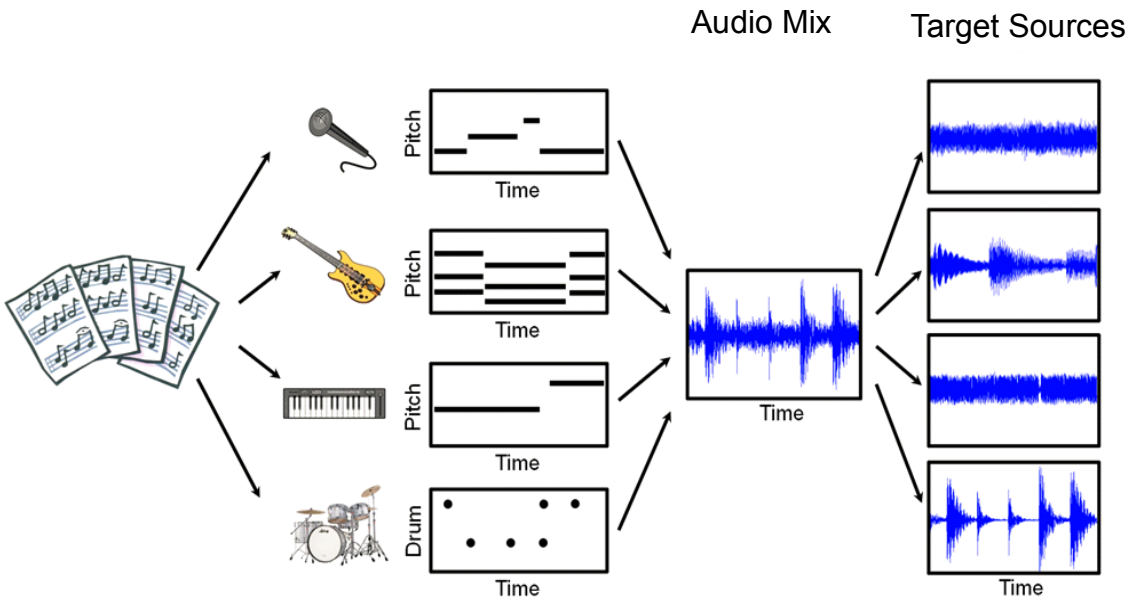


Figura: Separación de Señales de Audio [1]

1. What is Sound Source Separation?

- A Definition -

The definition of the target source is often lose:

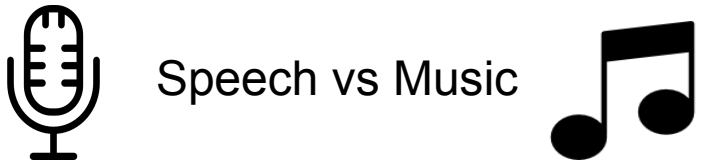
- Harmonic/Percussive Separation
- Solo/Accompaniment Separation
- Singing Voice Separation

→ Extremely relevant both for model design and evaluation.

1. What is Sound Source Separation?

- A Definition -

The creation process of the audio mixture varies greatly depending on the application:

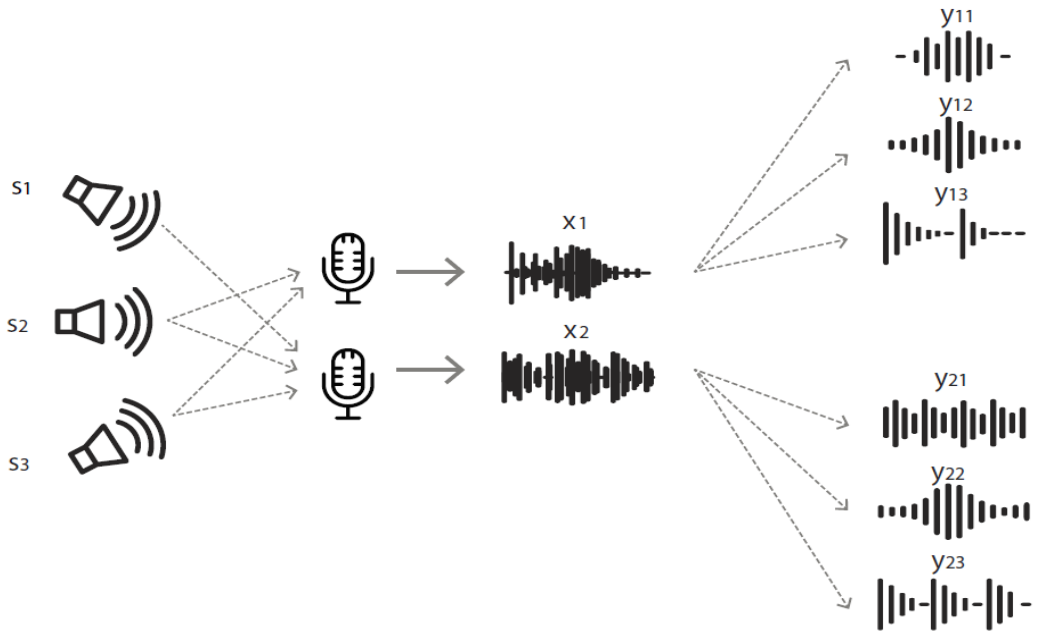


1. What is Sound Source Separation?

- A Definition -

The creation process of the audio mixture varies greatly depending on the application:

Speech

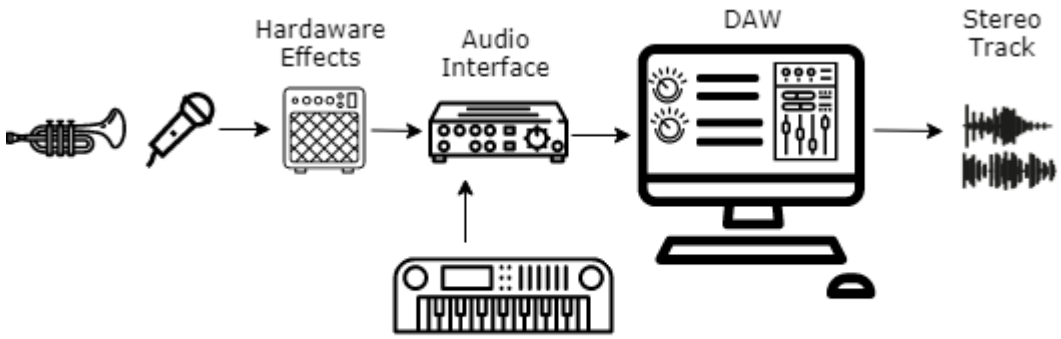


1. What is Sound Source Separation?

- A Definition -

The creation process of the audio mixture varies greatly depending on the application:

Music



→ Understanding the creation process of the mixture is critical for the development of separation algorithms.

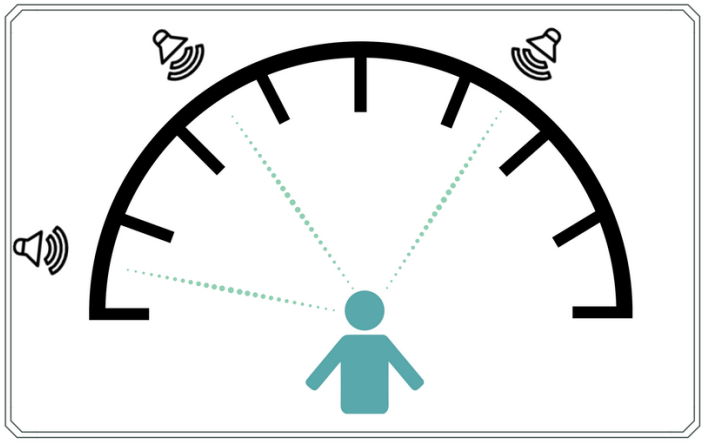
2. Methods for Sound Source Separation
- Categorization -

- Models of the source position
- Models of the source
- Models for interference reduction

2. Methods for Sound Source Separation - Models of the source position -

Assumption:
The target source is predominant in a given panning direction.

Implications:
- Prior knowledge of the source location is necessary.
- The model cannot handle overlapping sources in the stereo panning
- Minimum stereo recordings are needed.

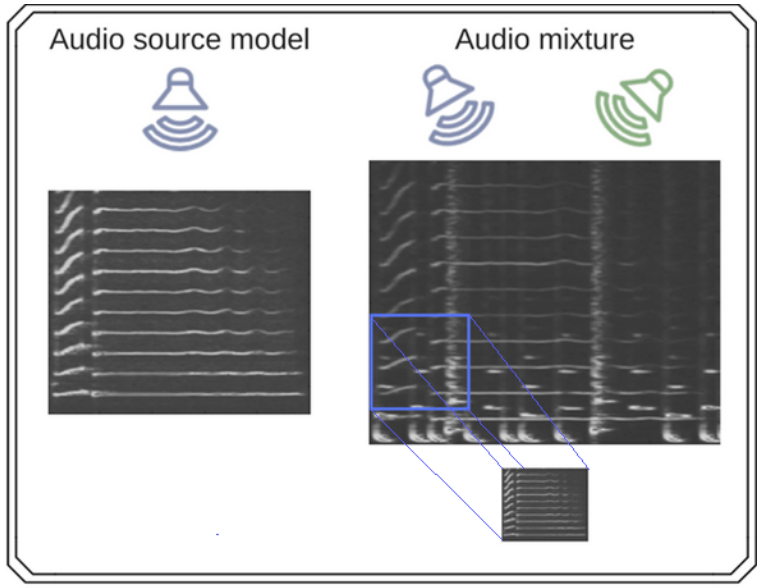


Models of the source position

2. Methods for Sound Source Separation - Models of the sound source -

Assumption:
The spectral characteristics of the target source - in time and frequency – are well known and can be modeled.

Implications:
- Source characteristics need to be well-understood
- An independent model for each source is needed
- Non-harmonic sources can be more difficult to model.

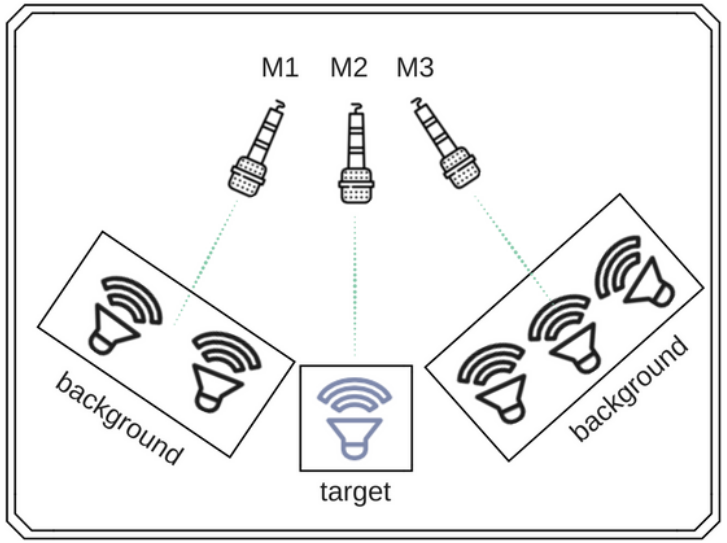


Models of the sound source

2. Methods for Sound Source Separation - Models for interference reduction -

Assumption:
There is at least one microphone that predominantly captures the target source and at least one microphone that predominantly captures the interference.

Implications:
- Multi-microphone recordings are needed
- Performance usually increases with increased number of microphones
- Depending on the number of microphones, processing times can be long.



Models for interference reduction

3. Applications of Sound Source Separation
- Examples -

Pre-Processing	Final Goal
Music Transcription [2]	Re-mixing [5]
Audio Classification	Upmixing [6]
• Musical instruments [3]	Gaming [7]
• Engine sounds [4]	Leakage removal

Applications

accusonus

Audionamix
SEPARATE2CREATE®

technicolor

4. Evaluation of Sound Source Separation

- An open challenge -

BSS: SDR, SAR, SIR, ISR [8]

↓

PEASS: OPS, IPS, APS, TPS [9]

↓

Reserachers reporting inconstencies with the metrics [10]

↓

Roll back to BSS → SiSEC Campaign

What now?

Other alternatives? [11-13]

What about listening tests?

Take home messages

- A clear definition of the target source is critical both for model design and evaluation.
- Understanding the creation process of the mixture will result in better separation algorithms.
- Do no neglect the importance of a clear evaluation procedure!

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Thank you!

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