

PRIMARY-AMBIENT SOURCE SEPARATION FOR UPMIXING TO SURROUND SOUND SYSTEMS



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1. Introduction

Most recordings are 2-channel stereo recordings

Surround sound systems provide an atmosphere beyond the content of the stereo recording

Extracting spatial information enhances upmixing

One way is by separating the primary-ambient sources:

- **Primary Sources:** Sources perceived as coming from certain direction
- **Ambient Sources:** Sources perceived as a surrounding sound coming from all around



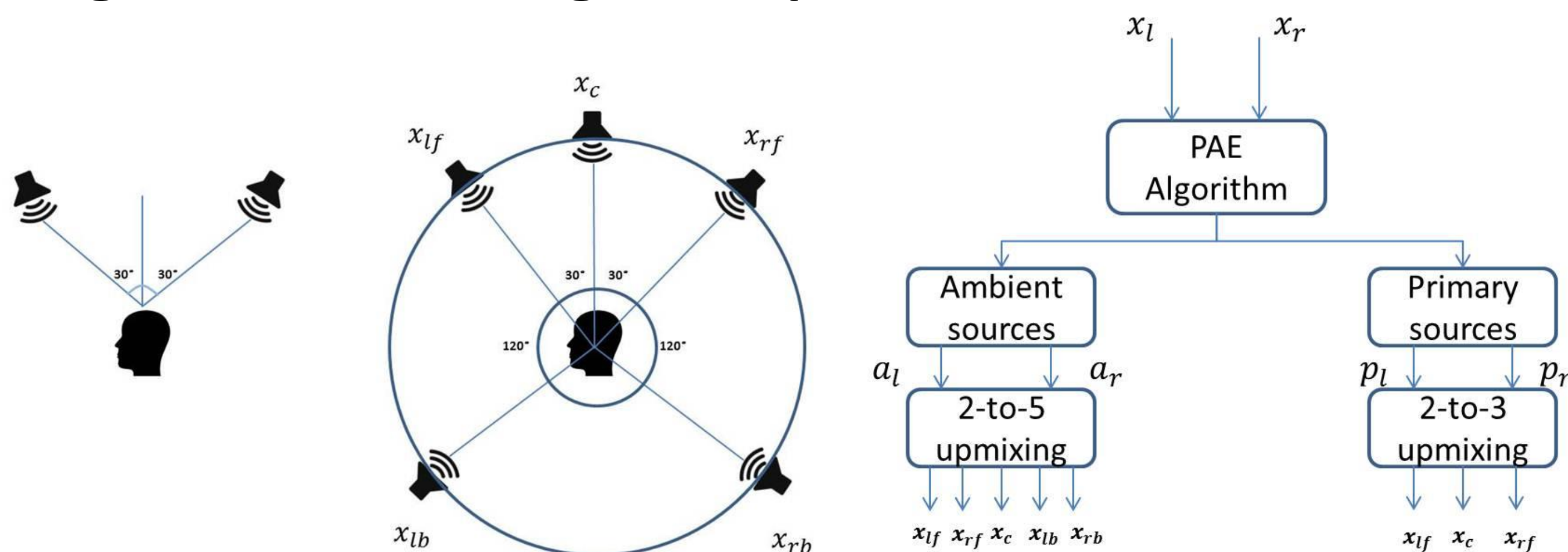
2. Applications

Channel upmixing:

A common application is upmixing from n to m channels, where $m > n$

The primary sources are directed to the front channels to preserve the intended direction of the sound in the recording

The ambient sources are directed to the all the channels to give a surrounding atmosphere



3. Proposed Solution

Idea: Use classification approach for primary-ambient separation

Classifier decides for each time-frequency point how much the signal is primary/ambient

Input: Feature vector describing the time-frequency point

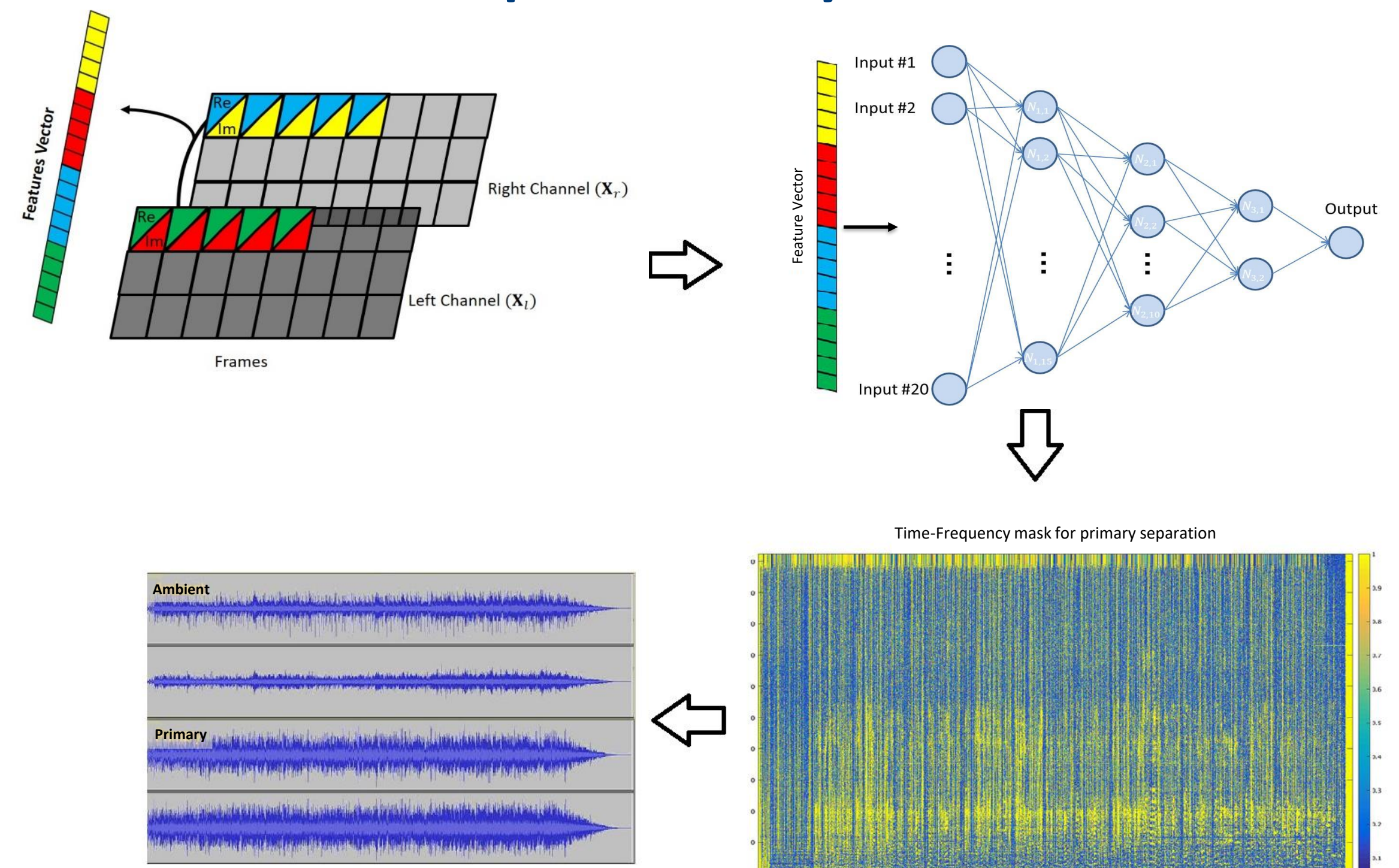
Output: Probability that this time-frequency point is primary/ambient

4. Computational System

Network is trained independently on ambient and primary signals

A dataset of 100 primary sources and 100 ambient sources were collected for the training step.

Proposed System

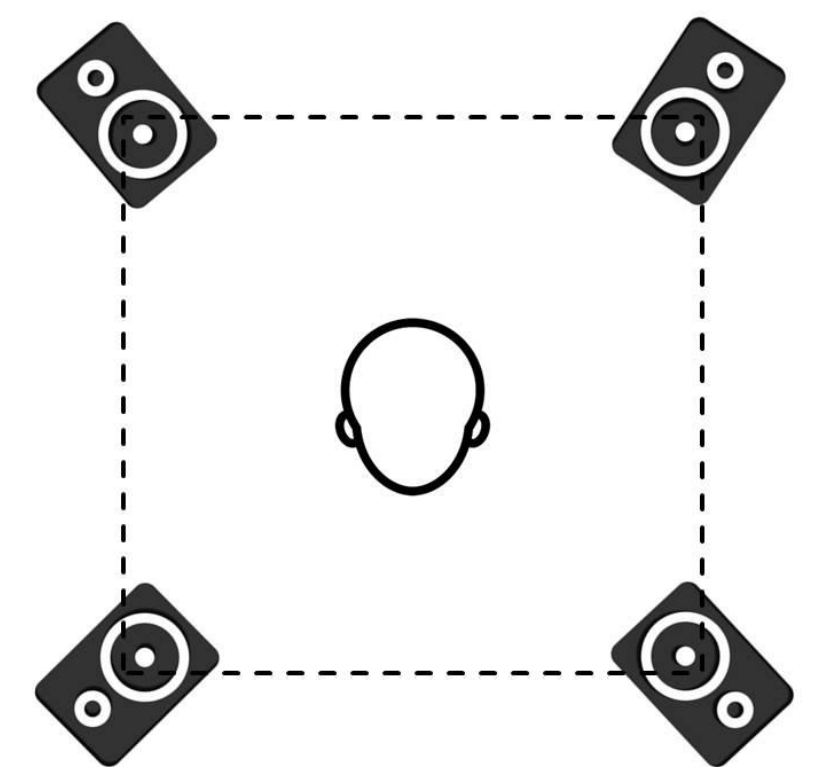


5. Evaluation

Our subjective evaluation is based on a listening test where different methods were played anonymously and users were asked to rate them.

Participants: 11

Task: order from 1 to 5 (1 is best)



Playback Systems Evaluation

Mono	Stereo	4CH	Ambient Back	Ambient All
4.5	3.7	2.6	2.5	1.6

Separation Systems Evaluation

Neural Network	PCA by Goodwin	Avendano	Panning Estimation
1.6	2.5	2.9	3.0

Our objective evaluation is based on the **BSS_Eval** toolbox

The evaluation is performed by mixing one ambient source with one primary source and then applying the five different PAE methods and evaluate the results using **BSS_Eval**.

