

# Personal Multi-Sound Zone Reproduction

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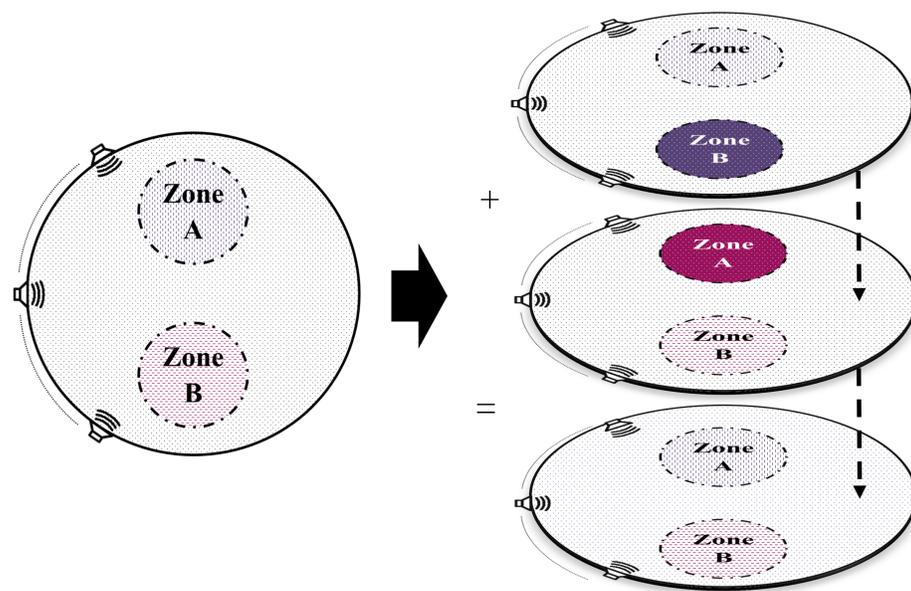
## Introduction

- Our environment is submerged by audio-visual reproduction devices. A same living space might contain several laptops, tablets, audio systems, smartphones or televisions.
- How to deliver to each user his own audio programme by means of loudspeakers with minimal interference between the different programmes?
- Multi-sound zone reproduction, aims to reproduce audio content over multiple regions of space without physical isolation or headphones
- The concept of multi-sound zone has recently drawn attention due to its possible applications in a great number situations: cars, planes, movie theatres, auditoriums, living rooms, offices ...



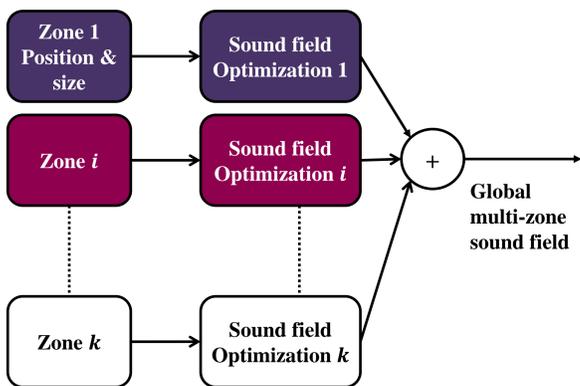
## Creation of multi-sound zones

- Division of the acoustic space into 2 or more zones
  - Dark zone: zone of **low energy** density
  - Bright zone: zone of **high energy** density
  - Rest of the domain remains **uncontrolled**
- A multi-sound zone problem can be resolved by linear superposition of several two-zone problems
  - Sound program A reproduced in zone A, zone B is quiet
  - Sound program B reproduced in zone B, zone A is quiet
  - Programs A and B reproduced respectively in zone A and B with interferences between zones



## Problem Formulation

- With linear superposition, if n-bright zones are required then **n-problems** need to be solved **independently**
- Interferences generated from coexisting problems are **not considered**
- It leads to **uncontrolled interferences** between the zones
- **Sound quality** is highly dependent on interferences from other concurrent zones



$i = 1, 2, \dots, K$  Creation of sound zones based on separated sound field optimization and linear superposition

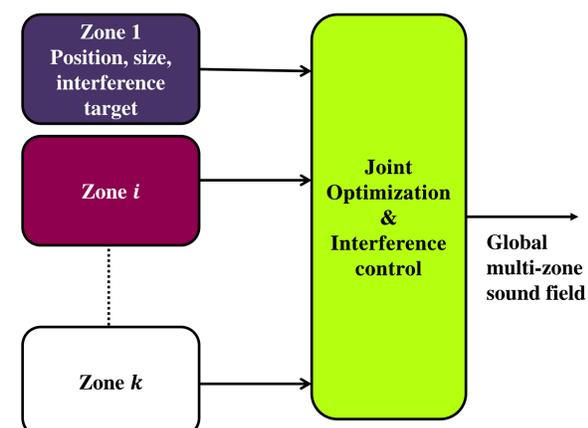
## Research Novelty

### Proposed Approach

- Optimizing zones with **respect to interferences** from other zones
- Optimizing all zones within the same problem by mean of **multi-objective** methods
- Solving the problem by **iterative approach**

This approach allows to

- **Reduce interferences** between zones
- Find a suitable **compromise** between bright and dark zones reproduction
- **Balance acoustic energy** allocation between zones depending on requirements



$i = 1, 2, \dots, K$  Creation of sound zones based on joint sound field optimization



### REFERENCES

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### ACKNOWLEDGEMENTS

The author would like to thank Pr. Kondoz, Dr. Hyun Lim and Dr. Jeroem Doumen for their support and contributions.  
This work was carried out as part of CLOUDSCREENS, a Marie Curie Initial Training Networks action funded by the European Commission's 7th Framework Program.

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