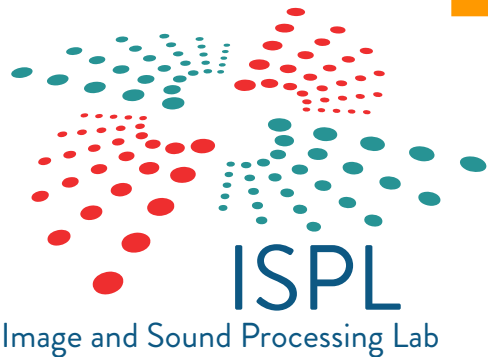POLITECNICO DI MILANO

ISPL
Image and Sound Processing Lab

Radiance Estimation Homework

Mirco Pezzoli

Instructions

- Homeworks can be done in groups up to 3 people

- You must upload on the beep folder the exercise files and a report describing the work you have done.

- The deadline for uploading your solutions is 23:59 - 16/01/2021

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Homework instruction

- All the files must be included in a .zip file named:
  - `yourIDnumber_surname_homework_radiance.zip`

- The file must include:
  - A short report with a section for each exercise including
    - Explaination of exercise solution,
    - Comments on the obtained results, as suggested on the slides.
    - Complete the report with plots and everything you find useful for better explain your results.
  - The source code.

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Radiance pattern estimation

- Describe in details the measurement experience
  - You can use pictures taken during the measurement session
  - Screenshots of the lesson recording

- Implement the radiance pattern estimation explained in class

- The problem is described on the slides (note: setup is different):
  - `08_radiance_of_sound_sources`
  - `Pages 16-28`

- A detailed description of the theory on radiance estimation is provided in the set of slides
  - `08_radiance_of_sound_sources`

- Complete the code template given:
  - From **exercise 1 to exercise 5.**

Radiance Pattern Estimation

Measurement setup:

- Genelec Speaker

- Semi-anechoic room (Polimi Cremona)

- 1 microphone

- Source rotates over 24 angles

- Sound source signal:

  - White noise

  - Sine sweep (from 50Hz to 22kHz)

Signal 1   Signal 6   Signal 12

Examples of setup

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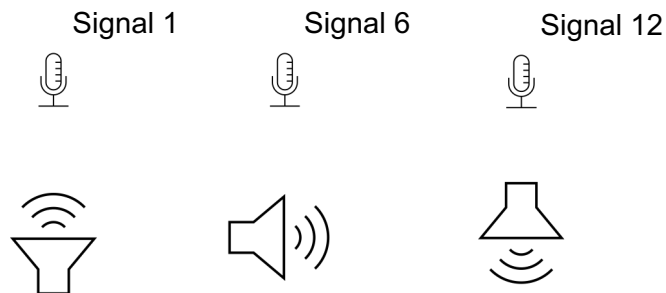
Signal observation

- Directivity describes emission of energy in space:
  - Higher energy at the pointing direction
- Simple analysis concerning the signal energy
- Write a matlab script exercise1.m that:
  - Loads the recordings
  - Associates a label to each audio signal
  - Inspects the energy of the signals

- Comment the results? What do you expect from the setup? Are your consideration verified?

Exercise 2

Room reflection analysis using autocorrelation

- Write a matlab script in order to estimate the first reflection time

- Visually analyze the autocorrelation of the signals

- Compute the delay between the direct and the first reflection
- Compute the distance from the reflector

- Check the results with both takes and source types
- Which source signal works best and why?

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Room reflection analysis using impulse responses

- Write two matlab scripts in order to estimate the first reflection time

- Compute the IR using the provided functions
  - (a) noise source
  - (b) sine sweep

- Compute the TOA of the direct path
- Compute the distance from the source
- Compute the delay of the first reflection
- Compare the results with respect to the autocorrelation method

Radiance estimation directly from the signals

- Write two matlab scripts in order to estimate the radiance of the sources:
  - (a) noise source.
  - (b) sine sweep.

- Cut the recordings using a window of appropriate length:
  - Avoid reflections.
  - Do not smooth the direct signal.
- Estimate the radiance from the windowed signals.

- Investigate the effect of different window length.
- Comment the results obtained with the two source signals.

Radiance estimation from the impulse responses

- Write two matlab scripts in order to estimate the radiance of the sources:
    - (a) noise source.
    - (b) sine sweep.

- Cut the IRs using a small window:
    - Centered around the direct path
    - Cut reflections

- Estimate the radiance from the windowed signals.

- Investigate the effect of different window length.
- Comment the resuts obtained with the two source signals.