 POLITECNICO MILANO 1863	051483 Musical Acoustics Module 2: Modeling of musical instruments Academic Year 2021/2022	Homework Laboratory IV Radiance estimation
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Assignment: Radiance estimation

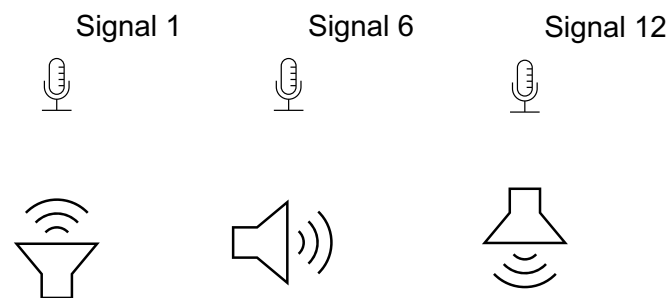
Implement the estimation of the directivity pattern starting from the measurements performed during the lab. Describe in detail the measurement experience, you can use pictures taken during the measurement session or screenshots of the lesson recording

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**.

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)



Examples of setup

Exercise 1

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:
 - Load 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 considerations 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?

Exercise 3

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

Exercise 4

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

Exercise 5

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

Please provide the answers in a report as a PDF file which explains how the measurements have been performed, your implementation choices for the estimation of the radiance patterns and comments on the obtained results. Complete the report with plots and everything you find useful for better explain your results. In addition, you have to provide the source codes.

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

yourIDnumber_surname_homework_radiance.zip

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Upload the required file using the WeBeep platform in the “Assignment HL4” delivery folder. One file for each student must be uploaded. If more than one student participated to the assignment, write on the cover page of the assignment the name, surname and ID of the participating students.