

Acoustic Engineering

Seminar 3: Computing the transfer function and simulating the room effect

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1 Introduction

In this session we will take a look at the **transfer function**, an extremely important concept to understand how a vibration is finally perceived with the sound characteristics that we perceive. In other words, how an emitted sound is transformed into the perceived sounds by the listeners.

Regarding instruments, the transfer function encapsulates how the instrument transforms the musician's input (like the vibration from a guitar string or breath through a flute) into sound waves. Essentially, it describes the unique "voice" of the instrument by showing how it amplifies, resonates, and filters different frequencies as sound travels through its body. That is, the transfer function derived from an instrument provides a blueprint for its tonal characteristics, resonance, and harmonic structure. How is your family of instruments transforming the input musician's input?

Regarding the room effect, the transfer function allows us to capture and simulate the acoustic characteristics of a room, describing the room's reverberation and echo patterns. Then, the transfer function of a room can be applied in digital environments to study the room effect, and it let us know questions like *how would your instrument sound in a particular room?*

2 Topics for Seminar 3

The goal of this seminar is to:

- Compute the transfer function and the impulse response, clearly understand these concepts and their physical implications, and use them to replicate an instrument sound transmission chain.

- Simulate the effect of a given room using its impulse response and understand the impact of the room effect when playing music.

For this seminar, please follow the instructions and complete the provided Jupyter notebook, which you can open and execute locally, or you may upload to Google Collab. In the notebook, you will find code examples, templates, instructions as how to proceed, and questions to ask and discuss.

3 Submission

Remember that seminar submissions are due one week after the class. You should submit the completed **.ipynb Jupyter notebook** file with the implemented code, performed experiments, and responses and discussions to the proposed questions.

Make sure all the code you write and execute works. No need to extensively comment or test the code, but make sure to discuss all the requested aspects and contents. Use markdown cells for extensive discussions and questions responses! Import all necessary dependencies and remember that **Jupyter notebooks store the variables until you close or you kill the kernel**. Make sure you don't keep unwanted values to important variables.

Please, **do submit the notebook in Aula Global with your surnames in the filename**, e.g. plaja_modrego_seminar3.ipynb.