Impulse Response Measurement

A MATLAB Experiment for Purdue ECE 301

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Part I: Recording the impulse response h(t).

Prerequisites

1. Bring your own smart phone or any device that can record .wav files. (Note the voice memos app on the iPhone records .m4a not .wav but can still work for the experiment.)
2. Prepare XXXX (something for generating the impulse signal.) A few examples of things that can generate an impulse are a single clap of your hands, dropping a book flat on the floor, or clapping your shoes together. No matter what you decide, try to make the impulse as loud and as short as possible.
3. Bring some kind of watch/timer that can measure the time when the recording is on.

Making the Recording

Students can pick ANY two locations of your choices.

1. You will be recording the impulse response of two different venues. ~~The instructor will decide the first venue and make arrangements for students to collect their recordings.~~ Students will choose their own venue for the second recording and make their own arrangements to collect their recordings. (The chosen location should have acoustical properties different than a normal room, i.e. echos, reverberations, interference. In addition, the location should be free from background noise or you will not be able to obtain an adequate impulse response. A few suggestions for the second recording are empty stairwells or some of Purdue's underground tunnels.)
2. While at your venue, ensure the room is as quiet as possible. When the location is free from background noise, you may begin the recording process.
3. Set the sampling frequency of the recording device to 44.1kHz. ~~The stock Voice Memo app on the iPhone samples at this rate by default.~~ Other apps or devices may not be initially set to this rate, but you should still be able to change it.
4. Set the recording device on a firm location so it will not move/shift when it is started/stopped. Ensure you are able to see a watch/timer while the recording is in progress. (Many smart phone apps have visible timers when the recording is being collected. If you have a partner to help, they may operate the recording device and watch the timer.) Prepare your impulse generating device.

44.1kHz is the industry standard of the recording format. There are plenty of free apps that can support such format. You can also use some MATLAB code like: `Fs_old = 48000 ; Fs_new = 44100; [P,Q] = rat(Fs_new/Fs_old); impulse_resampled = resample(impulse,P,Q);` to convert the sampling rates. There are also many free online links that can convert the sampling rates: E.g. https://audio.online-convert.com/convert-to-wav

5. Start the recording and get in position to generate an impulse. Ensure there is at least 4 seconds of silence, then generate the impulse. Continue recording for at least 4 seconds being sure that no other sounds are generated.
6. Stop your recording and review it to make sure:
    a. the impulse was captured
    b. no other background noises are present in the recording
    c. there are at least 4 seconds of silence prior to the impulse, and
    d. the recording lasts for at least 4 seconds after the impulse

    If the recording is satisfactory, then move to step 7.
7. Repeat the experiment until you have obtained 3 recordings in case one of the recordings does not work well.

Final Remark:

In Parts II and III, we are going to use the impulse responses you have recorded to see whether we can "recreate" the acoustic environment within computer. Namely, we will use a high-quality audio file, denoted by x(t), and then pass x(t) through the impulse response h(t) of the acoustic environment of your recording. Finally, we will listen to the final output signal y(t)=x(t)*h(t).

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