

48541 Signal Theory — Assignment 3

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In this assignment, you will implement a simple version of the system that you specified in Assignment 1, to correct for a more complex version of the room or channel that you characterized in Assignment 2. This is a *teamwork* assignment, except for the individual reflection.

As always the assignment must be submitted electronically by **noon** on the due date. There will be **no extensions** granted, for any reason. *See UTSONline for turnitin codes.*

Due date and time: Noon, Tuesday 8th November 2005

Where to submit: <http://www.turnitin.com/>

1 Digital Room Correction project

In Assignment 2, you characterized a listening room in terms of its impulse response, frequency response, linearity, and so on. If you did a good job, you used not only an impulse to determine the room's frequency response, but some other technique as well.

In this assignment, you will implement “correction” for the room in Matlab, and evaluate the results both technically and subjectively.

Your deliverable for this assignment consists of:

- A written report describing the system that you have implemented, and the results of your testing. This will include some of your work submitted with Assignments 1 and 2 — the final report should be self-contained.
- Your Matlab code that implements your system. Each function must include “help” information. Instructions for running the system must be included in your written report.

1.1 Room simulation

You will be using a slightly different version of the room simulation function. Download it from UTSONline—it is called *roomat*. This function takes additional arguments compared to the one used in assignment 2:

1. *stdid*. Your student ID.
2. *x*. The input signal, as a column vector.
3. *fs*. The sample rate.
4. *location*. A number between 1 and 3.

The *location* argument specifies which of three measurement locations are to be simulated by the *roomat* function. This corresponds to three (fairly close) listening positions in the room — your room correction must work for all three positions, or at least make none of them any worse!

1.2 Correction filters

You are required to create a correction filter for the room using two different methods:

1. By using a combination of bandpass, bandstop, highpass, and lowpass filters. You will design these filters by observing the frequency response of the room and specifying parameters to the appropriate Matlab filter design program.
2. By synthesizing a single correction filter impulse response from the room impulse response. (You can then use a single FIR filter to implement the correction filter.)

Note: do not naively try to compensate for the room's response across the whole frequency spectrum. Refer to your research from assignment 1 to determine an effective and sensible way to proceed.

1.3 Evaluation

You will test the two correction filters in two ways:

1. In a technical sense, by calculating the frequency response of the combined room and correction filter system, and
2. In a subjective sense, by playing music through the simulated room with and without the correction filters, and comparing. Note that your choice of music will have an effect on your ability to discern differences!

Your written report must carefully describe everything that you have done, and you must justify and explain all you have done with the *signal theory* that you have been studying this semester. A careful approach to problem-solving evident in the report (rather than “just try everything”) will yield higher marks. The report must also include instructions on how to execute your Matlab program(s).

1.4 Personal reflection

Write a personal reflection describing your learning in the course of this assignment in particular, and in the subject in general. Your reflection should describe particular problems or issues that you have encountered, and how you overcame them. (2 pages max.)

Submit the reflections as an Appendix to the written report.