

Homework #7: Chapter 8 and 9 (due Fri. Nov. 16, 2012)

Note

Due to the difficulty of this assignment, this homework will count $2\times$ as much as a usual homework.

Preliminary

- All problems are worth +10 points unless otherwise noted.
- Download the CompanionFiles7.zip file
<http://www.ece.nmsu.edu/~pdeleon/Teaching/EE395/Homework/CompanionFiles7.zip>
Download, build (make), run, and verify the companion C passcode. This codes utilize the PortAudio API to read and write samples to the sound card. This is the same code as in Homework #0
- Please attach at the *end* of your assignment printouts of plain.c, allpass.c, and source files for the Schroeder reverberator (initialize_program.c, process_signal.c, user_data.h, and util.h).
- Prof. De Leon appreciates EE395 students' assistance offered to other students in building the PortAudio passcode on various platforms in use.
- Code the following tool from *DSP Software Toolkit* Chapter 7: **rectangl.m** and **hamming2.m**
- Please scale your magnitude response plots so the dB range is reasonable.
- Please attach at the *end* of your assignment printouts of **main5.m** (code to solve software problem 5), **main6.m** (code to solve software problem 6), etc... as well as any new tools developed in this assignment.

Software Problems

Use your software tools to solve the following problems.

1. Implement the plain reverberator, plain.c (see p. 364). Use the file I/O passcode and plot (plotsig.m) 100 samples of the impulse response with filter parameters $D = 10$ and $a = 0.8$. Compare to Figure 8.2.6.
2. Implement the allpass reverberator, allpass.c (see p. 365). Use the file I/O passcode and plot (plotsig.m) 100 samples of the impulse response with filter parameters $D = 10$ and $a = 0.8$. Compare to Equation (8.2.29).
3. Implement Schroeder's reverberator (see p. 365-367) using the plain and allpass reverberators and the filter parameters. Use the file I/O passcode to recreate Figure 8.2.19.
4. Implement Schoeder's reverberator using the PortAudio API. Use the supplied user_data.h for filter parameters appropriate selected for $f_s = 48000$ Hz. Demo your program during office hours after the due date.
5. Plot a length-32 rectangular window. Plot the magnitude response [dB vs. ω (rads/sample)] of the window. From your magnitude response plot, indicate/verify with Figure 9.1.2, the mainlobe height, mainlobe width, relative sidelobe level, and location of spectral nulls.
6. Repeat Problem 5 but with a Hamming window. Use Figure 9.1.4 for verification.

7. Use your tools to recreate the plots in Example 9.1.3. You may either superimpose the rectangular and Hamming spectra or create separate plots.
8. Use your tools to recreate the plots in Example 9.1.4. Use the `dft.m` tool and not the `fft`.
9. Recreate the first column of plots on Figure 9.3.2.