

ECE 320 SIGNALS AND SYSTEMS II
Matlab Project I
Fall 2002

Issued: Thursday, September 5, 2002

Due: Monday, October 7, 2002

The purpose of this project is to reinforce your understanding of discrete-time convolution. After familiarizing yourself with the use of Matlab's `conv` command, you will develop a function that implements overlap-add block convolution. Block convolution is used frequently in digital signal processing. You will use the function you develop to filter a noisy audio signal.

You are *must* to work in groups on this project. Groups will be assigned by Monday, September 9. Each group will turn in a single writeup. The writeups must include all of the analytical (*i.e.*, pencil/paper) work, Matlab plots and code, and relevant explanations. A list of guidelines for preparing the writeup of this project are given below. Failure to comply with these guidelines will result in a grade of **ZERO** for the project.

- The report must be neatly handwritten or typed, and all pages must be numbered.
- All plots must be neatly annotated with x-axis and y-axis labels and a title.
- When referring to plots in the text, you should do at least one of the following:
 - use figure numbers, e.g., “Figure 1 is a plot of the signal $x[n]$.”
 - cite the page number they are on, e.g., “The figure at the top of page 4 is a plot of $x[n]$.”
- All Matlab code must be well-documented and should be included in the report.

1 Discrete-Time Convolution

Do all of the exercises in Section 2.7 of *Computer Explorations in Signals and Systems* by Buck, Daniel, and Singer. Your writeup should include answers to all of the questions in the book and any other observations you make as you complete the exercises.

Additional instructions:

- While many overlap-add implementations use the `fft` command to implement the convolution for each block, I *am not* asking you to do this. You should use the `conv` command instead. A discussion of the `fft`-based implementation is beyond the scope of this class. You will learn more about it if you take a senior- or graduate-level class in signal processing.

2 Filtering of a Noisy Audio Signal

As the final part of this project, use your function `oafilt` to filter the noisy audio signal contained in the file `proj1_data.mat` (which may be downloaded from the course website). You may load the data file by typing `load proj1_data.mat`. The file contains 3 variables:

- `fs`: sampling frequency in Hz

- `h`: vector containing the impulse response of a 61-point FIR filter
- `sig`: vector containing the noisy audio signal

Once you have loaded the data, do the following.

1. Play the signal using Matlab's `soundsc` command. What do you hear?
2. Filter the signal using your `oafilt` function. Play the resulting signal. Is there a difference? Can you identify the words?

Your writeup for this part should include answers to the above questions along with plots of the noisy signal and the filtered signal.