

**Matlab Project I**

Fall 2004

**Issued:** Tuesday, September 7, 2004**Due:** Tuesday, October 5, 2004

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.

Each student must do his or her own work on this project, however you may ask other students for advice. As stated in the guidelines given in the ECE 410 course information packet, you should identify any students you collaborate with. Your writeup 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.

- 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. Any graph not labeled will be considered not handed in.
- I will not spend time trying to figure out which graphs are for which problems. When referring to plots in the text, I recommend doing 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 an appendix at the end of 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. We will discuss the `fft`-based implementation later in the course.

## 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 `projI_data.mat` (which may be downloaded from the course website). You may load the data file by typing `load projI_data.mat`. The file contains 3 variables:

- `fs`: sampling frequency in Hz
- `h`: vector containing the impulse response of a 61-point FIR filter
- `noisysig`: 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? If you've done it right, you should be able to hear a segment of the orchestral piece "Arrival of the Queen of Sheba" by Handel.

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