

# ELEN 444-Ji: Digital Signal Processing

## Matlab Project, Due midnight, Wednesday, April 26

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Intelligence obtained a speech communication recording of a terrorist. However, the signal is corrupted by sinusoidal noises from a siren. As a signal processing expert, you were asked to analyze the recording and remove the corruption as much as possible. Following the step-by-step instructions below and using your DSP knowledge learned in this class, design and implement Matlab programs to process the signal.

Evaluation: Your projects will be evaluated based on all materials you turned in. In addition, we will pick up the top 10 best projects and play them in the class. The whole class vote and the best three will receive a Best Sound Effect Award with the signatures of your classmates.

1. After Friday, March 24, go to the course website, download the data file proj444.wav. In Matlab, read in the data using "[x,Fs,Nbits] = wavread( 'proj444' );". Play the sound using "wavplay(x,Fs)" and listen to it. Note:  $F_s$  is the sampling rate.  $Nbits$  is the number of bits per data.  $x$  is the digital signal that you will process. Use 'help wavread' for details.
2. Compute and plot the magnitude spectrum of the signal using DFT. Identify the peaks of the spectrum and estimate the frequencies of the sinusoidal interferences.
3. Design an order-N FIR filter using any of the FIR design methods to reject the interference signal. (you must choose for yourself the desirable characteristics of the filter.) Sketch your desirable  $H_d(\omega)$  and obtain  $h(n)$ , your filter coefficients.
4. Compute and plot the frequency response (magnitude and frequency) of your designed filter.
5. Using convolution algorithm to process  $x$ , i.e., run "y=conv(x,h);". Then truncate to get the valid (central) portion of the output signal. Apply any tricks that you'd like to have to enhance the sound quality (scaling, truncation, smoothing, whatever). Run wavplay(x,Fs) to listen to your result. Then run "wavwrite(y, Fs,Nbits,'your-LastName-Firstname.wav');" to output your result.
6. Summarize your findings in an electronic report (word file) with all the plots are your observations.

You may find the following commands in Matlab helpful: *fft*, *fftshift*, *plot*, *conv*, *fir1*, *fir2*, *firls*, *abs*, *angle*

**What to turn in: Email to JIMXIUQUANJI@gmail.com, before due data, your report, Matlab scripts, electronic report (word file), and the final 'LastName-Firstname.wav' file before due date.**

Have fun!