**ECE 4522/5514: DIgital Signal Processing**

# Computer Assignment (CA) No. 3: Frequency Domain Analysis

The goal of this assignment is to introduce you to simple frequency domain analysis using the discrete Fourier transform (and the Fast Fourier Transform). You will use your buffering program for this implementation:

cat x.raw | my\_buffer\_program | play -e signed -c 1 -b 16 -r 8000 -t raw -

Set your frame duration to 10 msec (80 samples) and your window duration to 30 msec (240 samples). Compute the spectrum of the signal using the discrete Fourier transform (DFT) for each frame. Implement the DFT as a function call. Demonstrate that your result matches MATLAB by selecting several frames and differencing the two spectra (and showing the differences are zero). Note that you must do this on a frame by frame basis -- not by computing a DFT of the entire signal. Watch out for scaling issues.

Next, zero-stuff the spectrum to 512 points for each frame. Again compute the spectrum, but this time use both your discrete Fourier transform function and a Radix-2 Fast Fourier Transform (FFT). Code for the latter can be easily found on the Internet. Compare the amount of time each compute takes. How much faster is the FFT? Does it give an identical result?

Next, create a simple filter using your filter program from the previous assignment:



Filter the original audio file using your filter program, and then analyze this file using your frequency domain analysis tool. Demonstrate that the filter is doing the right thing by inspecting the frequency response of the signal.