EECS 3602 Lab 4 : Filters

Submission details: Write your responses to the following questions and submit them electronically as a lab report, along with any code that you write. If your responses are handwritten, scan them for electronic submission. Submission is via Moodle. Due date: November 19, 2015.

Grading details: 70% of your lab grade is for correctly completing the lab requirements; 20% is for clear writing and good presentation, including readable and well-documented code; 10% is for extra work or analysis that expands on or goes beyond the lab requirements.

Part 1: Finite impulse response filters. Using the method described in class, write the following functions:

- `lowpass(OmegaC,N,window)`, which implements a low pass filter with cutoff frequency `OmegaC`, offset `N`, and `window` as specified below, and returns the filter's causal FIR impulse response $h[k]$ (of length $2N + 1$).
- `highpass(OmegaC,N,window)`, which implements a high pass filter with cutoff frequency `OmegaC`, offset `N`, and `window` as specified below, and returns the filter's causal FIR impulse response $h[k]$ (of length $2N + 1$).
- `bandpass(OmegaC_low, OmegaC_high,N,window)`, which implements a band pass filter with cutoff frequencies `OmegaC_low` and `OmegaC_high`, offset `N`, and `window` as specified below, and returns the filter's causal FIR impulse response $h[k]$ (of length $2N + 1$).

Note that the cutoff frequencies must be between 0 and π (though you don't need to check that they are). The `window` is specified as follows:

- `window = 0` : Rectangular window
- `window = 1` : Bartlett window

- `window = 2` : Hamming window
- `window = 3` : Hanning window
- `window = 4` : Blackman window

where each type of window is given in the textbook in section 15.1.2.

For each function, plot example frequency responses of the filter for each window (all on the same plot for easy comparison). Discuss any differences you observe with the windows.

Part 2: Application of filters to signals. Illustrate the behaviour of the filters by applying them to the following kinds of signals:

- *Periodic square wave and sawtooth signals.* Submit plots of inputs and outputs for various filters, pointing out any interesting features. Discuss your results in your report.
- *Sound signals.* Using MATLAB's audio and input functions, capture a sample of your voice and/or other sounds, and apply them to your filters. Submit the input and output audio files. Discuss your results in your report.