EECS 360 Signal and System
Lab 8. DFT and FFT

March 24, 2008

1. Use equation (1) to to implement Discrete Fourier Transform for the following signal:

$$X_k = \sum_{n=0}^{N-1} x_n e^{-j2\pi kn/N} \quad k = 0, \ldots, N-1 \tag{1}$$

$$x[n] = \begin{cases} 0, & \text{for } n \in [-128, -65]; \\ 1, & \text{for } n \in [-64, 63]; \\ 0, & \text{for } n \in [64, 127]. \end{cases}$$

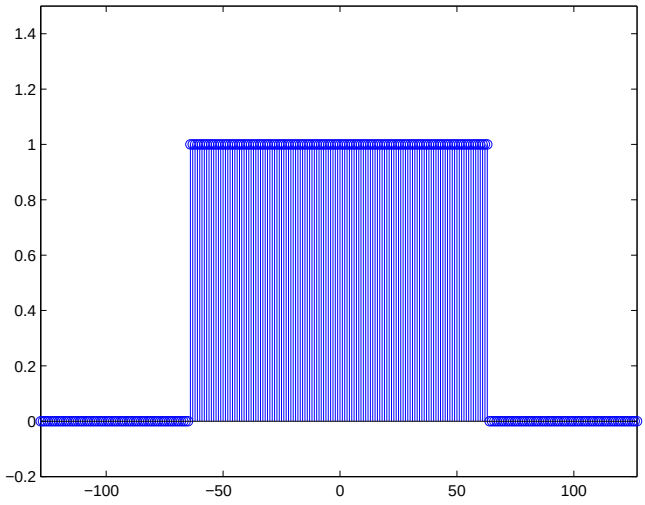

Figure 1: Signal $x[n]$

Use the "*stem*" and "*plot*" commands to graph the original sequence, the magnitude of the spectrum, and the phase of the spectrum.

2. Use the built-in Matlab *fft* command on the sequence given in problem 1. Compare your results to your DFT results. (hint: They should be the same)

3. Use the *tic* and *toc* commands in Matlab to time how long it takes for each of the Discrete Fourier Transform techniques (DFT/FFT) to calculate the frequency response. Be sure to time only the calculating functions, not plots or other unrelated events. Which technique is the fastest?

4. Repeat step 3 for different sequence lengths (very short ~ 10, short ~ 50, medium ~ 200, long ~ 500, very long ~ 1000). Is one technique always faster or slower than the other?