

Lab Assignment #2

ECE 565, Spring 2009

(Posted on Tue, 7 April; report due in class on Tue, 21 April)

Load the .mat file “pressure” into your Matlab workspace. The signal $x[n]$ is a 24-h long time series (i.e., a DT signal) of the air pressure measured in North Amherst from 00:00 ET through 24:00 ET on 18 March 2008. The data, given in hPa (hectopascals), were collected with an ultrasensitive quartz-crystal barometer.

(a) Determine the length N of $x[n]$. Find the angular sampling frequency Ω_s (unit: radians per second), the sampling frequency f_s (unit: samples per second), and the sampling period T_s (unit: seconds).

(b) Design three bandpass filters with a passband ranging from 0.15 Hz to 0.3 Hz. Choose the DT window length M such that the window covers 10 minutes of data. Use a rectangular window for the first filter, a Hann window for the second filter, and a Blackman window for the third filter. — Write down the equations that describe these filters in the time domain and in the frequency domain, respectively.

(c) For each of the three filters, plot the desired impulse response $h_d[n]$, the desired magnitude response $H_d(e^{j\omega})$ (y-axis in dB), the actual impulse response $h[n]$, and the actual magnitude response $H(e^{j\omega})$. — Explain the plots one by one. Explain the differences between the desired and the actual filters.

(d) Apply the filters to the 24-h long data set. Plot the filter output sequences with different time resolutions. — Explain the results.

(e) For 60-minute intervals, compute the mean filter output amplitude, A , and plot the time series of A for the entire 24-h period. — Describe and explain your results.