Homework 7

Due: Friday, October 13, 2006, in class

Reading: cf. `http:/www/nd.edu/~mhaenggi/ee344/overview.html`

Problems from textbook: 3.60a,b,d,i; 3.62; 3.63; 3.71(a)*; 4.1; 4.2; 4.3; 4.21b,c,e.

* Note that $f_s(t) = K \int v(t)dt$.

Additional problem:
Let $x[n]$ be a periodic signal with FS coefficients a_k for period $N = 8$. Show that the FS coefficients of $(-1)^n x[n]$ are a_{k-4}.

Problems from exercise book: 3.8.

Matlab problems:

(a) Write a program which creates two signals of length $N = 16000$, $x_1[n] = \sin(2\pi \cdot 100n/N)$ and $x_2[n] = \sin(2\pi \cdot 4000n/N)$, and another, $x[n] = x_1[n] + x_2[n]$. Listen to all three of them using `soundsc()`. Find the values and indices of the non-zero FS coefficients of this sum of sinusoids in the given window length $N = 16000$.

(b) Now filter the sum of the signals using your `diffeqn.m` function and both sets of coefficients used in Homework 6. You may input $x[-1] = y[-1] = 0$ for this exercise. Save the two separate outputs into two output files named `sinfilt1.mat` and `sinfilt2.mat`, then concatenate them into a single vector to listen to the original sum and the two filtered versions in order. Record your assessment of what you've done. Plot the first 500 values of all three signals in separate plots in a single figure using `subplot()`. Save the postscript version of the plot with `print -dpsc filename`.

(c) The Matlab function `fft(x)` computes a scaled version of the discrete-time Fourier series (DTFS) of $x[n]$. The DTFS is also known as the discrete Fourier transform (DFT) and is computed by an algorithm known as the fast Fourier transform (FFT); hence the function name. Use `fft` via `X=(1/N)*fft(x)` to compute the DTFS of $x[n]$ and the two filtered signals, then plot the magnitudes (`abs(X)`) of the three in three plots in a single figure using `subplot()`. Comment on the way the DTFS plots reflect the filtering effect you described in part (b). You may use this result to check your FS coefficients in (a). Put your program (with comments and DTFS coefficients), filtering results and postscript plot into your dropbox.