

CEN 501 – Fall 2015
Part I Signal Processing and Analysis

Semester Project
Power Spectral Estimation

Due Date: 10-14-15 (Day of Exam 2)

You will be working with the following data sets:

Data Set #1: Create a 128-point real data sequence consisting of unit-amplitude sinusoids at 5 Hz, 15 Hz, and 16 Hz. Let the sampling frequency $f_s = 64$ samples/second.

Data Set #2: Create a data record identical to Data Set #1, but add white noise such that the signal-to-noise ratio (SNR) is 0 dB.

For each data set:

(a) Form Blackman-Tukey Power Spectral Density (PSD) estimates with lags of 10 and 20. Use a Hamming window and unbiased correlation estimates.

(b) Form Welch Periodogram PSD estimates. If N samples are divided into P segments of D samples each, with a shift of S samples between adjacent segments, let $S = 10$ and 20 , and let $D = 32$. Use a Hamming window.

For each of the PSD estimation algorithms discussed above, calculate 4096 PSD points in the interval $-f_s/2$ to $f_s/2$. Plot all PSD estimates as Power (dB) vs. frequency (Hz).

Submit a typed report in WORD format with a separate chapter corresponding to each algorithm (i.e., (a) and (b)) as discussed above. In each chapter, discuss the theory behind the algorithm and clearly identify your observations with respect to variables such as autocorrelation lags, shift between adjacent segments, etc. Include an introduction chapter that describes the overall experiments, how you created the test signals, and any implementation details. Include a final chapter that compares and contrasts the two algorithms, and draws conclusions based upon the observed results.

In addition, submit two MATLAB programs (.m files) that I can run to verify your findings—one for each algorithm. The PSD estimation programs are to be written discretely from scratch without using any predefined MATLAB functions or libraries whatsoever!!! Each program should be completely automatic and display the appropriate figures simultaneously. For example, for part (a), the program should display 4 figures, appropriately labeled. Securely attach a CD-ROM with your programs to the inside of the front cover of your report. All programs must run on MATLAB 2012b.

Note: You must include all support code and data necessary to run the MATLAB programs directly from your CD. If I cannot run your code directly from your CD, you will not receive credit for the project.