EECS 3602 Lab 5 : Filtering Random Processes

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: December 9, 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: Generating Gaussian random processes. Write the following functions:

- `randn_mv(mu,sigma2,k)`, which generates a $1 \times k$ vector of IID Gaussian random variables with mean `\mu` and variance `sigma2`.
- `mean(x)`, which estimates the mean of the $1 \times k$ random process `x`.
- `autoc(x,tau)`, which, given the $1 \times k$ random process `x`, estimates the autocorrelation at offset `tau` (i.e., $R_x(\tau)$).

Discuss how you design these functions, and give sample outputs. Show that the autocorrelation at $\tau = 0$ correctly outputs the variance. Try the autocorrelation for processes with nonzero mean.

Part 2: Filtered Gaussian random processes.

- Using the functions you wrote in part 1, apply filters of your choice to IID Gaussian random processes. Give the theoretical autocorrelation of the output, and compare it to the output of your `autoc(x,tau)` function.
- Give the theoretical power spectral density of an IID Gaussian random process through a low-pass filter with $N = 20$ and a rectangular window. Obtain the power

spectral density as the discrete Fourier transform of your autocorrelation function estimate. Do they match reasonably closely? (If not, try a longer sample length.) Discuss.