

ECE528: Matlab assignment 2
Spring 2018
Due on Tuesday April 24, 2018 via Blackboard

Computing PSD. See Page 2 of the class note for April 11, 2018.

1. Consider the random process defined as

$$X[n] = 2U[n] - 4U[n - 1].$$

where $U[n]$ is a white noise with zero mean and variance $\sigma^2 = 1$.

- (a) Is this process WSS? If so, evaluate the auto-correlation sequence and power spectral density.
 - (b) Generate a realization of 1000 samples of $X[n]$ by using MATLAB. Based on this realization, estimate the power spectral density using the periodogram and plot the estimate. Compare the PSD estimate with the true PSD by plotting the two curves on the same figure.
 - (c) Can you propose a method to improve the estimate at the previous point? Verify by using MATLAB that the proposed technique improves the performance by plotting the corresponding estimate.
2. Consider a first-order AR process defined as

$$Y_n = aY_{n-1} + X_n$$

where the process X_n is white Gaussian noise, that is, a sequence of uncorrelated Gaussian random variables with zero mean and variance $\sigma_X^2 = 1$. $|a| \leq 1$. We aim to estimate the PSD $S_Y(f)$ of Y_n via simulations. To do so, you generate a sequence of X_n samples and then compute Y_n as the output of the AR process. Now, with a set of $\{Y_n\}$ at hand, you may compute its PSD using the two methods in the lecture note.

- (a) Choose $a = 0.25$. Plot the estimated PSD using both the periodogram method and the limited autocorrelation method. Specify the parameters used in your simulations. You may need to try several values for the block size K and the number of blocks L in order to obtain proper curves.
 - (b) Repeat for $a = 0.98$.
 - (c) Compare the two methods. And compare the two different values of a . Briefly explain your observations.