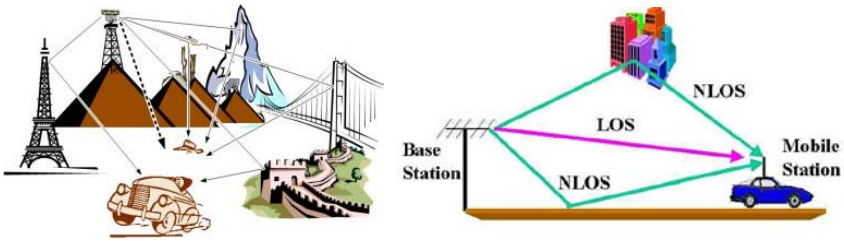
King Fahd University of Petroleum & Minerals
Department of Electrical Engineering
EE315 Probabilistic Methods in Electrical Engineering
Term Project: Fading and Noise in Wireless Communication Systems
Due: Tuesday, April 17, 2012 (Week 11)

Part I: (4%)



The radio propagation channel is probably the biggest challenge that any wireless system faces. Most of the time there is no single direct line-of-sight (LOS) link between the transmitter and the receiver, however, the transmitted signal undergoes multiple reflections. These effects result in multiple delayed (phase shifted) versions of the transmitted signal at the receiver. This project is studying the fading effect in multipath channels. The purpose of the project is to show that for a transmitted sinusoidal signal, the received signal is supposed to have a Rayleigh/Rician distribution, while the phase distribution is supposed to be uniform.

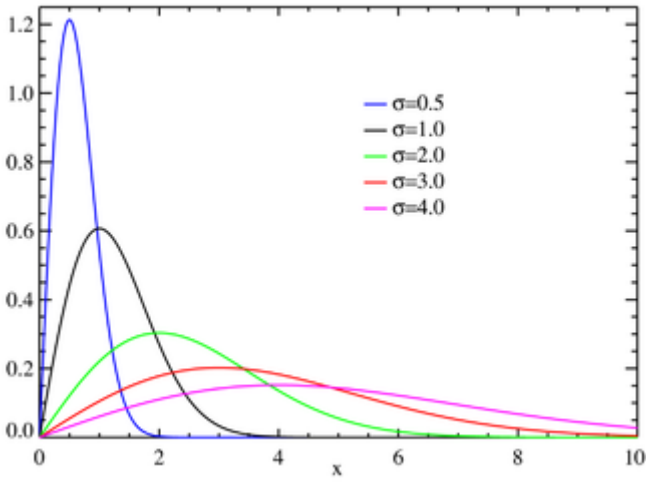
Specifically, consider the situation where the received signal includes a line-of-sight component and N scattered components, as shown by

$$X(t) = \sum_{k=1}^{N} A_k \cos(2\pi f_c t + \Theta_k) + a\cos(2\pi f_c t)$$

where $a\cos(2\pi f_c t)$ is the directly received LOS component. Assuming that Θ_k is uniformly distributed inside the interval $[0, 2\pi]$, and A_k lies uniformly in the interval $[-1, 1]$,

- Compute the histogram and the pdf of the envelope (amplitude) of $X(t)$ for N=10,000, and a=0, 1, 5, S_1, and S_2. Generate figures and discuss them.

- Compare your results with the Rayliegh and Rician distribution (Show and match the theoretical pdf in addition to your simulated results on the same plot).Discuss the matching parameters.
- Study the impact of reducing N: 1000, $S_2 + S_1$, $S_2 - S_1$. Justify.
- Comment… discuss… extend

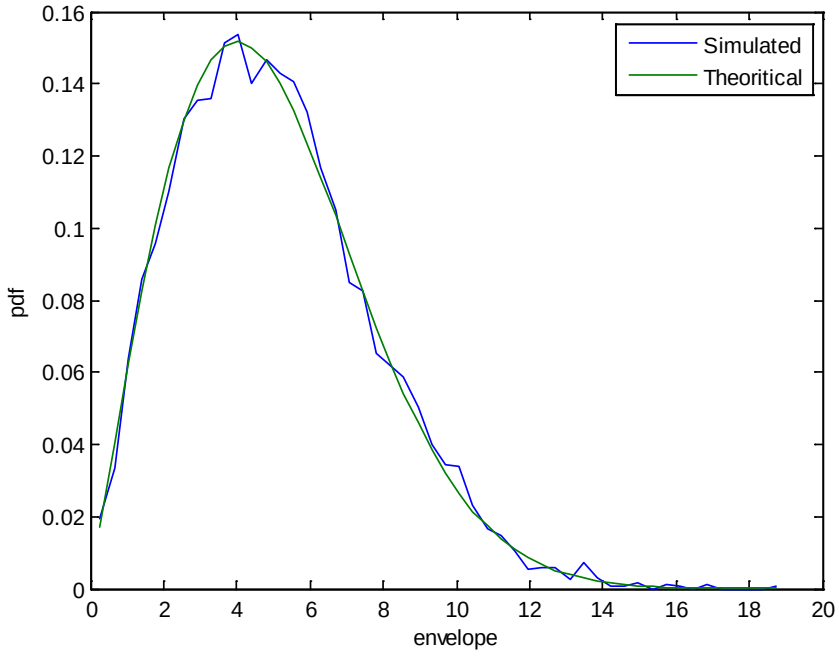


Part II: (3%): **(***Open ended problem***: AWGN through Low, band or high -Pass-Filters)**

Using MATLAB simulation, study how a low-pass filter would affect an AWGN. Show the autocorrelation, power spectral density, mean,….etc. Select the parameters of the input (single tone or multi tone) and the output to illustrate the effect. Support your plots with discussion.

You may use the following MATLAB functions: *scatter, xcorr, randn, mean, fir1, filter, xlabel, ylabel, title, grid, fft, ifft*

Instructions:

1. Writing style and organization are very important (Quality not Quantity!)
2. **Your serial numbers should be clearly presented on the first page.**
3. A group of two students work together and submit one report.
4. Include the code in your report. The names MUST be commented in the code.
5. You should make your output clear and nice. Use commands like (axis, xlabel, ylabel, title, legend, text)
6. Remember to use (**help**, **lookfor**) commands.
7. It will take some time. Allow yourself enough time. Do not work close to the due date.
8. Projects are to be submitted during class time. Any late submission will result in zero or low grade.
9. You can use the discussion group in the Course WebCT to discuss general ideas and questions. Copying is the easiest way to lose points. Both hard and soft copies will be required., Turn-it-in might be used to cross check.
10. You can ask questions related to the project until the end of week 9. No questions after that.

Good luck, Dr. Ali Muqaibel