ECE/EEE F311 Communication Systems (First Semester 2023-2024)
Lab-10 (Tuesday) (21-11-2023)

Objectives

In this task, the objective is to understand digital transmission using Nyquist criteria and random variable simulations.

Task

Digital transmission is an involved process where a transmitter sends encoded pulses over a channel for a receiver to be decoded correctly. However, the channel attenuation and additive noise are major impairments which cause errors in detection. Thus, the received signal is expressed as $y = \sqrt{P}hx + n$ where x is a constellation point, h is channel attenuation, P is the transmitted power, and n is the additive noise. The analysis of system now is restricted to a simple linear equation with SNR defined as $SNR = \frac{Ph^2|x|^2}{\sigma_n^2}$. Use BPSK modulation with constellation points $[-1, 1]$. Take $\sigma_n^2 = 2$, $h = \frac{G_t G_r \lambda}{4\pi d}$ with $d = 100$ m, $\lambda = 10$ m, and $G_t = G_r = 5$dB.

(a) Plot average BER (theoretical) versus P (in the range of 100 to 1000 in the interval of 10).

(b) Plot average BER (Monte Carlo) versus P (in the range of 100 to 1000 in the interval of 10). Both plots i.e., Monte Carlo and theoretical should be in one figure.

(c) Instead of BPSK, if QPSK or 4-QAM is used with two-dimensional constellations $[(1/\sqrt{2}, 1/\sqrt{2}), (-1/\sqrt{2}, 1/\sqrt{2}), (1/\sqrt{2}, -1/\sqrt{2}), (-1/\sqrt{2}, -1/\sqrt{2})]$, plot the scatter plot of transmitted constellation X and received constellation Y.