Digital Communication: UE20EC254

IV Sem ECE, PESU: Jan-May 2022

Project-2: BER for BPSK and BFSK

In this experiment, we find the bit error rate (BER) for BPSK and BFSK by simulation. The simulations will be done entirely in the signal space.

Part-1: BER for BPSK

Steps:

1. Generate the $N = 10^7$ length sequence $s(n)$ of random BPSK symbols (+1,-1). (Here $E_b = 1$)
2. Set the E_b/N_0 range (in dB) as -4:2:10.
3. For each value of E_b/N_0, perform the following steps:
   (a) For the given value of E_b/N_0, find the noise variance.
   (For example, if $E_b/N_0 = x$ dB, then $N_0 = 10^{-x/10}$ since $E_b = 1$. The noise variance is $N_0/2$)
   (b) Generate zero mean white gaussian noise sequence $w(n)$ of length N for that variance.
   (c) Find $x(n) = s(n) + w(n)$
   (d) Recover the input $s(n)$ from $x(n)$, by thresholding at 0. i.e, $\hat{s}(n) = 1$ if $x(n) > 0$, and $\hat{s}(n) = -1$ if $x(n) < 0$
   (e) Find the number of errors, and the bit error rate (no. of errors/N).
   (f) Find the probability of error using the expression derived in class.
4. Plot the bit error rate (on log scale) vs E_b/N_0 (in dB). Use the *semilogy* function.
5. Plot the theoretical BER (the probability of error expression) and verify that the two curves match.

Part-2: BER for BFSK

Here, the signal space is modeled as the complex plane, and the two symbols are represented by 1 and j

6. Repeat the same steps as with BPSK simulation, with the following differences:

   (a) Generate the $N = 10^7$ length sequence $s(n)$ of random BFSK symbols $(+1, +j)$.

   (b) The complex zero mean white gaussian noise sequence $w(n)$ is given by $w(n) = w_r(n) + jw_i(n)$, where both $w_r(n)$ and $w_i(n)$ have zero mean and variance $N_0/2$.

   (c) Find $x(n) = s(n) + w(n)$ and recover the input $s(n)$ from $x(n)$, by comparing the real part of $x(n)$ with the imaginary part of $x(n)$.

7. Plot the theoretical and simulated BER for BFSK and verify that they match.

8. On the same figure, plot the BER for BPSK and verify the 3-dB gap between them.

9. You need to upload a single figure that has theoretical and simulated BER curves for both BPSK and BFSK on it.