EXPERIMENT - 1

BPSK MODULATION AND DEMODULATION

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S7 ECE B BATCH

AIM

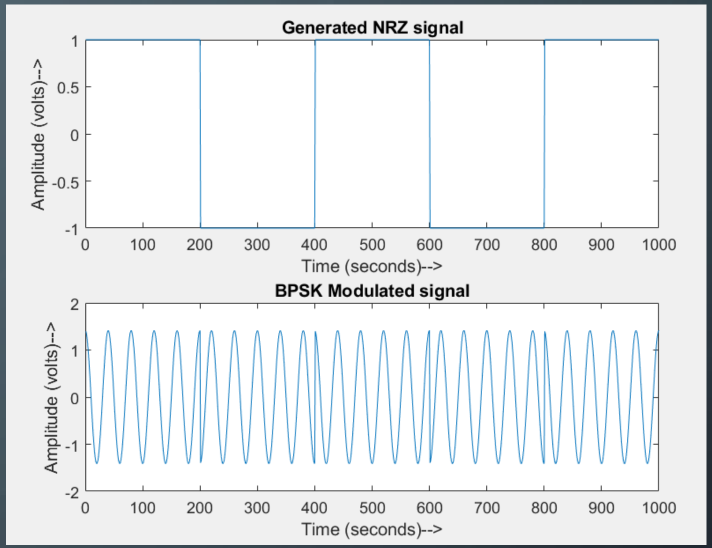
To simulate a digital communication system in the presence of noise that uses coherent BPSK with antipodal signalling and plot BER curves (Eb/No in dB vs. probability of bit error on a log scale) and to compare the error performance by

a. Plotting the original constellation diagram for the transmitted symbols assuming no noise. (Generate a random sequence of about 1024 BPSK symbols per frame.)
b. Adding AWGN with different variance values and plot the constellation diagram.
c. Applying coherent detection and compute BER for Eb/No in [0; 14] dB in steps of 2dB
d. Plotting BER versus Eb/No. Verify BER plot (simulations) with an analytical computation of BER for BPSK.

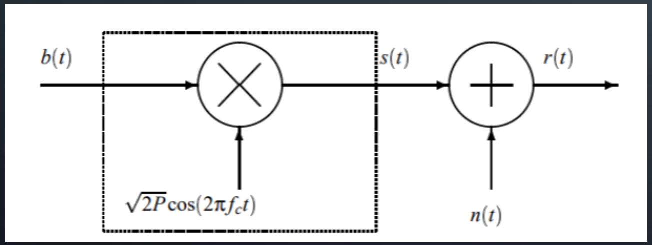
THEORY

Binary Phase Shift Keying (BPSK) - is a type of digital modulation technique in which we send one bit per symbol i.e., ‘0’ or a ‘1’(one for logic high, zero for logic low). Hence, the bit rate and symbol rate are the same. We only have 360° of phase to work with, so the maximum difference between the logic-high and logic-low phases is 180°. This makes these two waveforms **antipodal**.

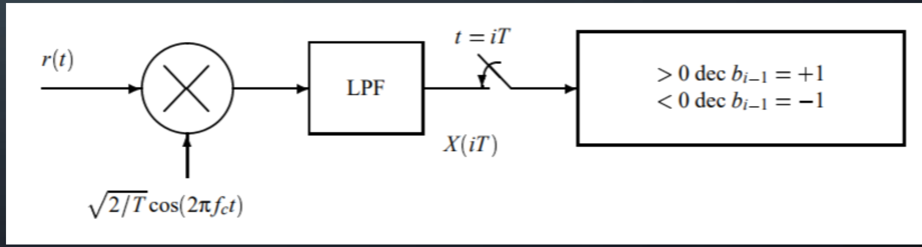
For input bits [1 0 1 0 1]



MODULATION



DEMODULATION



ALGORITHM

Step 1: Generating random sequence of 1024 BPSK symbols per frame. The generated symbols comprise of -1s and 1s since the bit stream consists only of 0s & 1s. Plot the original constellation diagram for the transmitted symbols assuming no noise.

Step 2: Create Gaussian noise with different noise power density values and observe the variations.

Step 3: Form received signals r = s+n with Eb/No in [0 : 14] dB in steps of 2dB.

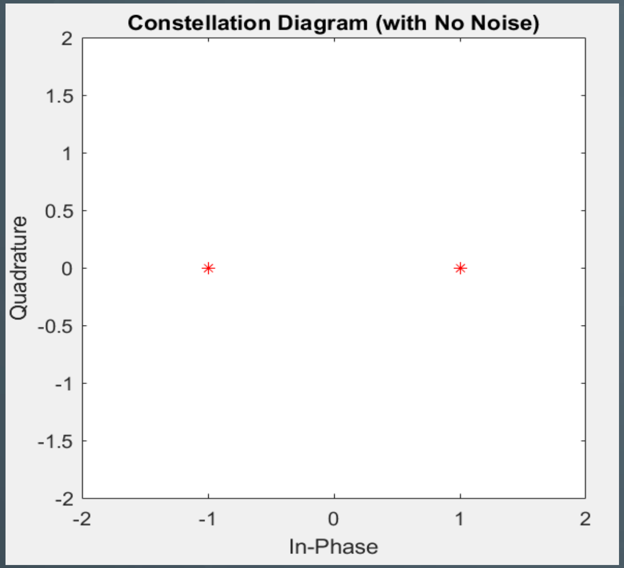
Decision formula:

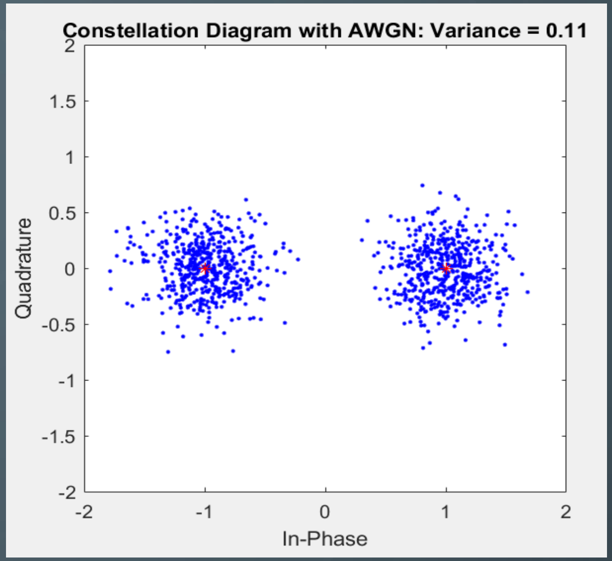
Mark as error if (r(k)>0 && s(k)==-1)||(r(k)<0 && s(k)==1)

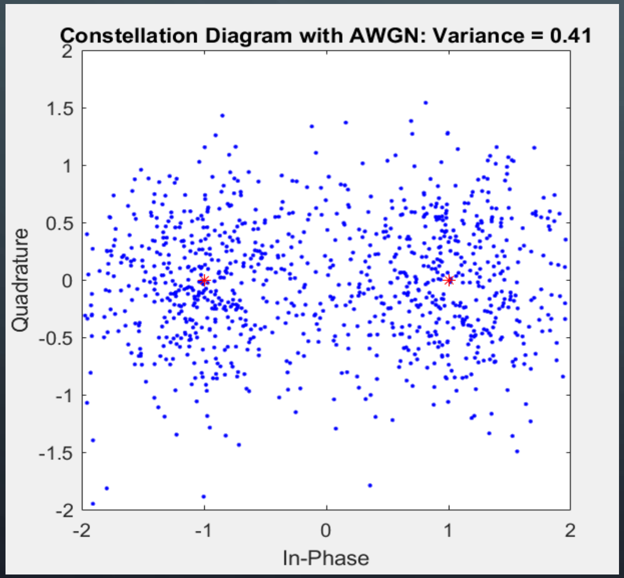
Compute the bit error rate for each SNR value.

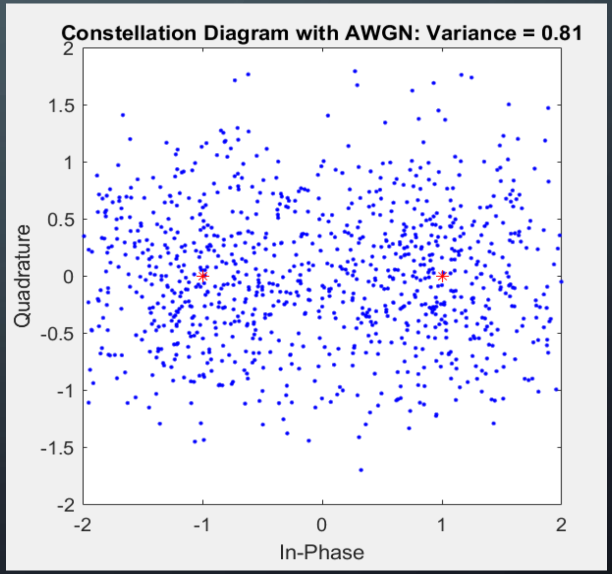
Step 4: Calculate analytical BER as BER_th=(1/2)*erfc(sqrt(SNR)). Verify BER plot (simulations) with the analytical computation of BER for BPSK.

OBSERVATIONS









INFERENCE:

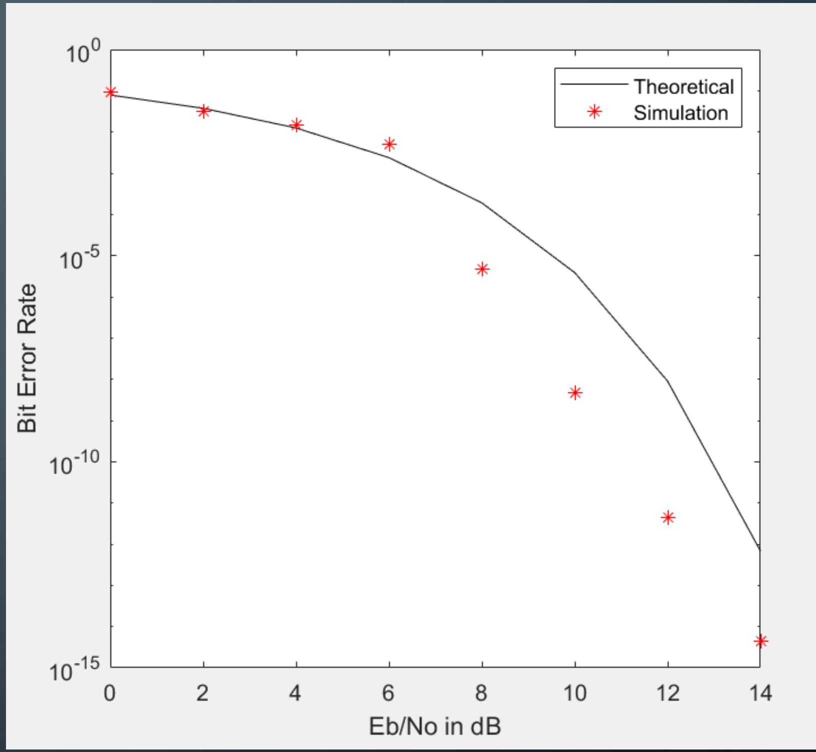
1. The **phase changes by 180°** when there is change in transmitted input bit (i.e, 0 to 1 or 1 to 0).

2. As variance of the noise **increases**, ie as SNR decreases, the constellation diagram becomes more populated with noisy signals.

3. As **SNR increases**, it can be seen that the variance of noise changes and the **BER decreases**, obtaining a waterfall graph.

RESULT:

The constellation diagram after adding AWGN was observed and the computation for BER is compared with its theoretical counterpart.



BER vs SNR: Simulated and theoretical curves