Lab Handout # 1
Performance analysis of various digital modulation schemes over AWGN Channel

Design LAB II(Software)
Instructor: D. RAWAL, N. SHARMA
Dept. of ECE, The LNMIIT, Jaipur

Time : 3:00 Hour Maximum Marks : 10

Instructions and information for students

- This Lab Handout consists of 2 pages. Please check that you have a complete copy.
- Simulate in matlab or any other Software.

Objective:

1) Analyze and Simulate BER performance of BPSK/QPSK signal over AWGN channel.

1) **Introduction**
2) **BER performance over AWGN channel**
   a) A BPSK modulated signal with power $P = E_b$ is transmitted over (AWGN) Additive White Gaussian Channel is affected by various types of noise, like thermal noise. This noise is additive in nature, has flat spectrum(white - uncorrelated), has gaussian PDF(probability density function).

$$Y = \sqrt{P} \cdot X + V$$

   where X is BPSK signal and V is gaussian noise $\mathbf{N}(\mu, \sigma^2)$.

   b) The PDF of **V** is given by

$$P(V) = \frac{1}{2 \cdot pi \cdot \sigma^2} \cdot exp(\frac{v - \mu}{2 \cdot \sigma^2})$$

   c) The BER expression (from the figure) for BER over BPSK is given by

$$Q(\sqrt{\frac{P}{\sigma^2}})$$

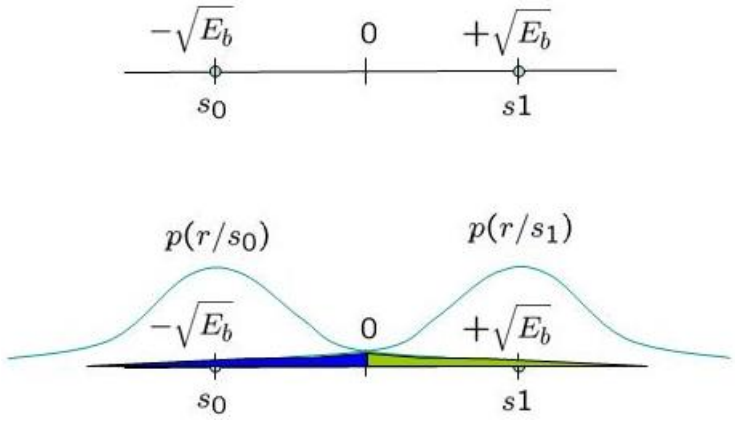

Fig. 1. BPSK over AWGN channel

1) **BER BPSK-AWGN**
   a) Generate a random binary sequence of 10000 values. Lets call it 'X' sequence.
   b) Generate Gaussian noise(randn function) and vary the snr(signal to noise ratio) from 0 to 24 in step of 4 db (or noise variance from 1 to 0.001), lets call it 'V' sequence. Use

$$SNR_{dB} = 10 \cdot log10(SNR_{linear})$$

   c) Now Apply thresholding on 'V'.
   d) Recover sequence $\hat{X}$.
   e) Find out the total error 'e' between input 'X' and recovered sequence '$\hat{X}$'.
   f) Plot your conclusion.
   g) plot theroretical curve and verify.

2) **BER QPSK-AWGN**
   a) Generate QPSK signal from a pair of bits of a random binary sequence.
   b) Add AWGN Noise of variance '0.5' in real and imaginary part of QPSK symbol.
   c) Decode the real and imaginary part separately using thresholding.
   d) Plot BER for QPSK signalling.

3) **Observations and Results**.
   a) Plot BER Vs SNR for BSK over AWGN(m-file) [2]
   b) Verify above results with the theoretical expression of BPSK over AWGN [2]
   c) Make a simulink model of the above. [2]
   d) Plot BER Vs SNR for QPSK over AWGN(m-file) [2]
   e) Plot BER Vs SNR for QPSK over AWGN(Simulink: Call the simulink model in m-file using 'sim' function) [2]

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