Lab Handout # 2
BER Performance over Wireless Channel

Design LAB II(Software)

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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 Wireless channel.

Itroduction:

1) **BER performance over Wireless channel**

a) A BPSK modulated signal with power P is transmitted over wireless channel accompanied by AWGN noise.

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

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 of BPSK over Wireless channel is given by

$$\frac{1}{2}\left(1 - \sqrt{\frac{SNR}{2 + SNR}}\right)$$

Where SNR_{linear} is signal to noise ration in linear scale.

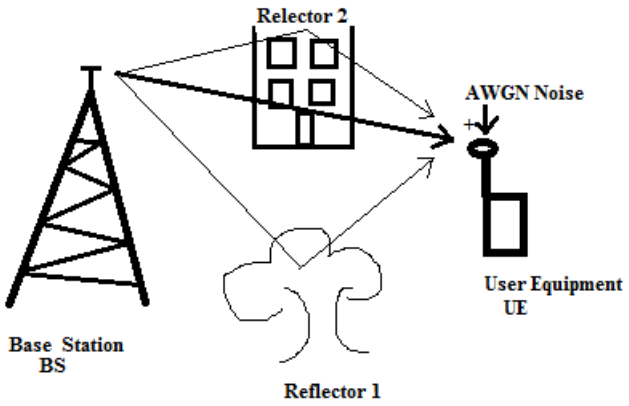

Fig. 1. Signal Transmission over Wireless channel

1) **Simulating BER of BPSK over Wireless channel**
   a) Generate a random binary sequence of 10000 values. Lets call it 'X' sequence.
   b) Transmit the above sequence over wireless channel, which is reperesented as an attenuation/amplification factor h.
   c) 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

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

   d) The received sequence is represented as

$$Y = h \cdot X + V$$

   e) At the receiver, the signal can be decoded as
      i) Decode Method 1:
         - Divide the received signal by h, call it Dec_1.

$$Dec_1 = \frac{Y}{h} = \frac{h \cdot X + V}{h} = X + \frac{V}{h}$$

         - Apply thresholding(compare greaterthan/less than zero) on Dec_1 and Generate $\hat{X}$.
      ii) Decode Method 2:
         - Multiply the received signal by h^* and divide it by norm $|h|^2$, call it Dec_2.

$$Dec_2 = \frac{h^* \cdot Y}{|h|^2} = \frac{|h|^2 \cdot X + h^* \cdot V}{|h|^2} = X + \frac{V}{h}$$

         - Apply thresholding(compare greaterthan/less than zero) on Dec_2 and Generate $\hat{X}$.
   f) Find out the total error 'e' between input 'X' and recovered sequence '$\hat{X}$'.
   g) Plot your conclusion.
   h) plot theroretical curve and verify.

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

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