Experiment (1)

Introduction to Probability of error calculation using MATLAB

Objective:

(1) Investigate the systematic procedure of evaluating the BER in communication Systems.
(2) Investigate the performance of digital communication system.

Theoretical Background:

(1) Evaluating BER for wireless communication systems:

To perform Monte-Carlo simulation (i.e. calculating the BER via simulations using MATLAB) you must perform the following

a. Generate an array of random bits.
b. Add noise (based on SNR).
c. Detect received bits from the noisy received signal
d. Count number of errors.
e. Previous steps are repeated large number of iterations and the BER is found by averaging.
f. Steps "a" to "f" is repeated per SNR.

(2)AWGN channel modeling:

To model the AWGN by its baseband equivalent you will generate a Gaussian distributed signal with total power (i.e. variance) equals to signal power/SNR.
For simplicity we always normalize the signal to unity so you can model the AWGN channel by the following equation

$$noise = \frac{1}{\sqrt{SNR}} * randn$$

Procedure:

(1) Simulation parameters:
    a. Number of bits/SNR=1e6 bits
    b. Signal to noise ratio range=0 to 30 dB with 2 dB steps.
(2) Generate random binary data vector (you can make use of `randint` or `randi`).
(3) Apply noise to bits (Hint: you must calculate the signal power in this case because it is not unity)
    `Rx_sequence=bits+noise.`
    Or
    `Rx_sequence=awgn(bits,snr,'measured')`
(4) Decide whether the Rx_sequence is '1' or '0' by comparing the samples with threshold=1/2 (Hint: try to use relational operators and indexing to make the code more efficient)
(5) Compare the original bits with the detected bits and calculate number of errors (you can make use of `xor` or `biterr`).

(6) Save the probability of error of each SNR in matrix , BER
```
BER=[BER  new prob. of error]
```
(7) Plot the BER curve against SNR (use `semilogy`)

Report requirement:

(1) Well commented M-file.
(2) Softcopy report containing required figure
(3) Calculation of transmitted signal power
(4) Identifying meaning of 'measured' field?
(5) At which value of SNR the system is nearly without error (for the given frame)?