

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)?