INDIAN INSTITUTE OF TECHNOLOGY
KANPUR

Assignment

Student name: *(TA): Mangal Jeet Singh (mangalj24@)*

Course: *EE622 Communication Theory* – Professor: *K Vasudevan*
Due date: *5th Nov, 2025, 10 pm*

Question

This question is with reference to the symbol-error-rate (SER) simulation [1] of MIMO systems in Rayleigh flat fading channels, in the presence of additive white Gaussian noise (AWGN). The simulation code has been written in Linux C language.

1. Simulate the given code and verify the results in Figure 2.34 of DCSP (online version). Vary the average SNR per bit from 5 to 35 dB, in steps of 2.5 dB. Plot the union and Chernoff bounds in the same figure.

2. Modify the code for simulating the SER of 8-QAM with minimum squared Euclidean distance equal to 4, in Rayleigh flat fading channels in the presence of AWGN, for the following cases, in separate figures:

   (a) $N_r = N_t = 1$, for SNR per bit in the range 5 to 55 dB, in steps of 5 dB.

   (b) $N_r = 2$, $N_t = 1$, for SNR per bit in the range 5 to 30 dB, in steps of 2.5 dB.

   (c) $N_r = 1$, $N_t = 2$, for SNR per bit in the range 5 to 55 dB, in steps of 5 dB.

   (d) $N_r = 2$, $N_t = 2$, for SNR per bit in the range 5 to 30 dB, in steps of 2.5 dB.

   Plot the union and Chernoff bounds for each of the above cases, in the same figures. Simulate over 10^8 vectors.

3. Upload the modified code. Clearly indicate the changes.

4. Identify the constant corresponding to the number of vectors simulated, in `mimotype.h`.

$(2 + 4 + 2 + 2$ marks)

Instructions. The assignment has to be solved independently without mutual discussion. Upload your answers in a single pdf file on Acadly. The modified code needs to be uploaded in *tar.gz format. Clearly mention your name and roll number.

References

[1] K. Vasudevan, *Digital Communications and Signal Processing, Second edition (CDROM included)*. Universities Press (India), Hyderabad, www.universitiespress.com, 2010.