

UNIVERSITY OF MORATUWA
Department of Electronic & Telecommunication Engineering

EN4384 – Wireless and Mobile Communications
Simulation Assignment

- Task 1 – Average bit error rate (BER) evaluation in fading channels
 - a) Plot the simulated average BER of binary phase shift keying (BPSK) in a Rayleigh fading channel for $\frac{E_b}{N_0}$ values from -10 dB to 10 dB, where E_b is the bit energy and N_0 is the power spectral density of additive white Gaussian noise.
 - b) Derive a theoretical expression for the BER of BPSK in Rayleigh fading channels.
 - c) Plot the theoretical values in the same figure with the simulation results.
 - d) Compare the BER results with an AWGN channel.
- Task 2 – Comparing diversity combining schemes
 - a) Plot the average BER of BPSK in a Rayleigh fading channel for $\frac{E_b}{N_0}$ values from -10 dB to 10 dB, using a 3-branch maximal ratio combining (MRC) receiver..
 - b) Derive and Plot the theoretical BER on the same figure.
 - c) Repeat a) for selection combining receiver.
 - d) Plot the results of Task 1 and Task 2 in the same figure.
 - e) Compare the diversity combining schemes in terms of the array gain and the diversity gain.
- Task 3 – SVD based decoupling of MIMO channel

Consider a 4×4 MIMO system with channel state information at both the transmitter and the receiver. The SVD based precoding is used at the transmitter while shaping is used at the receiver. The system is operating in a Rayleigh fading environment, where the elements of the channel matrix are independent and identically distributed zero-mean complex Gaussian random variables with variance 1. The noise variance is set to 1. Consider the total power available at the transmitter, P_t to take values 1W, 2W, 5W and 10 W. For each value of P_t , evaluate the achievable rate for the system with the following power allocation schemes.

 - a) Equal power allocation
 - b) Channel inversion power allocation
 - c) Allocating all power to the best eigenmode
 - d) Waterfilling power allocation.

Plot P_t vs average achievable rate averaging the rate values over 1000 channel realization per each value of P_t .

References:

1. Chapter 6 & 7 – Wireless Communications, Andrea Goldsmith

Please submit your results with codes Matlab/Octave/Python codes on or before November 08, 2025.

Individual viva will be held to test your knowledge on the solutions you have provided.