HW2b: Error Rate Evaluations for Baseband Systems

due October 24, 23:59

1. You have simulated the SER and BER performances of QPSK as a function of both the SNR and E_b/N_0. Plot those curves together and also include their theoretical symbol and bit error probability curves. Compare the results. Do the BER and SER simulation results match with the theory?

2. You have simulated the BER performance of BPSK as a function of E_b/N_0. Plot the simulated BER performances of QPSK and BPSK along with the theoretical bit error probability curve of BPSK. Does the simulation match with theory? How does the BER vs E_b/N_0 performances of BPSK and QPSK compare?

3. You have simulated the BER performance of 4-PAM as a function of SNR. Plot the simulated BER performances for uniform and grey mappings (2 curves) along with their theoretical bit error probability curves. Do your results match with theory?

4. You have simulated the BER performance of BFSK as a function of E_b/N_0. Plot the simulated BER performance with its theoretical bit error probability curve. Do your results match with theory?

5. Modify the MATLAB Monte-Carlo simulation package so that it implements a transmission system employing 16-QAM (use rectangular constellation). Employ both uniform and Grey-mappings for bit-to-symbol conversions. Run your code to obtain the bit-error rate (BER) as a function of SNR. Then plot the simulated BER results (2 curves) along with their theoretical bit error probability curves. Is there a difference in the BER performance due to mapping? Do your results match with theory?

   Hint: Notice that in your QPSK simulation code, the average symbol energy is set to unity. The SNR value is obtained by changing the noise variance. Previous constellations all had unit energy but in 16-QAM, different constellation points have different amplitudes and energies. Therefore you need to normalize the constellation points so that the average constellation energy is equal to 1.

6. Repeat the previous part for 8-PSK communication. Again employ uniform and grey mappings for bit-to-symbol conversions. Is there a difference in the BER performance due to mapping? Do your results match with theory?

7. In the end put all simulated BER curves together to see which modulation method has the best BER.

Instructions:

- In each part, All BER/SER curves will be semi-logarithmic, down to at least 10^{-4} BER/SER level and be plotted on the same graph so that we will be able to compare the results with the theory.

- You should prepare a report, where all your explanations, graphs and results are included. You are also required to turn in your MATLAB source codes. At the due date, submit your report and your Matlab codes (5 m-files in total, one for each constellation). All submissions are on MOODLE, paper copies will not be accepted.