

Digital Transmission Methods S-72.2205

Matlab homework 1

SER and BER simulations

The Monte Carlo simulation of symbol and bit error ratio relies on a stationary system property that the average over distribution coincident with the average over the sequence of the samples derived from the same distribution if the sequence approaches infinity. In this task we compare analytically calculated and simulated modulation performance.

Assume two system 8 PSK modulation and 16 QAM. All the calculations have to be made for signal to noise ratio values $SNR = [0, 2, 4, 6, 8, 10, 12, 14, 16, 18]$ dB .

Analytical part of the assignment

1. Calculate the symbol error probability for both of the modulations and for all the given SNR ratios. Plot the results as function of SER and BER versus SNR/bit.
2. Calculate the BER of 8 PSK constellation by using Gray mapping.

Hint: For simplifying your calculations you can use approximations of the decision areas.

Simulation

Construct a simulator and for evaluating BER and SER of both modulations for given SNR values.

3. Plot the calculated and simulated SER and BER curves.
4. Comment about the curves
 - a. Is there any difference between calculated and simulated values and if there is what is the reason?

Plot of the constellation diagrams

5. Generate 10000 random symbols from 16 QAM modulation. Plot the constellation diagram.
6. Assume a channel $h = 0.3939 + 0.9191j$ and the signal after channel to be $y_i = h \cdot s_i$. Plot the constellation diagram after the channel.
7. Add to each symbol a complex random noise value with variance corresponding to $SNR = 18$ dB. $y_i = h \cdot s_i + n_i$. Plot the constellation diagram of the noisy values.
8. Equalize the channel by multiplying the received symbols with the channel complex conjugate value $y_{eq,i} = h^* \cdot y_i$. Plot the constellation diagram.
9. Repeat the steps 5 to 8 for 8 - PSK.
10. Describe what has happened to the constellation diagrams.