Communications Lab: Experiment 6

Bit error rate of Differential BPSK (DBPSK) and Differential QPSK (DQPSK) in AWGN

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Theory

The following theory part is cited from the following link:

http://www.tjprc.org/publishpapers/--1365767395-11.Electrical%20-%20IJEEER%20-Ber%20perforamnce%20-%20HARJOT%20KAUR.pdf

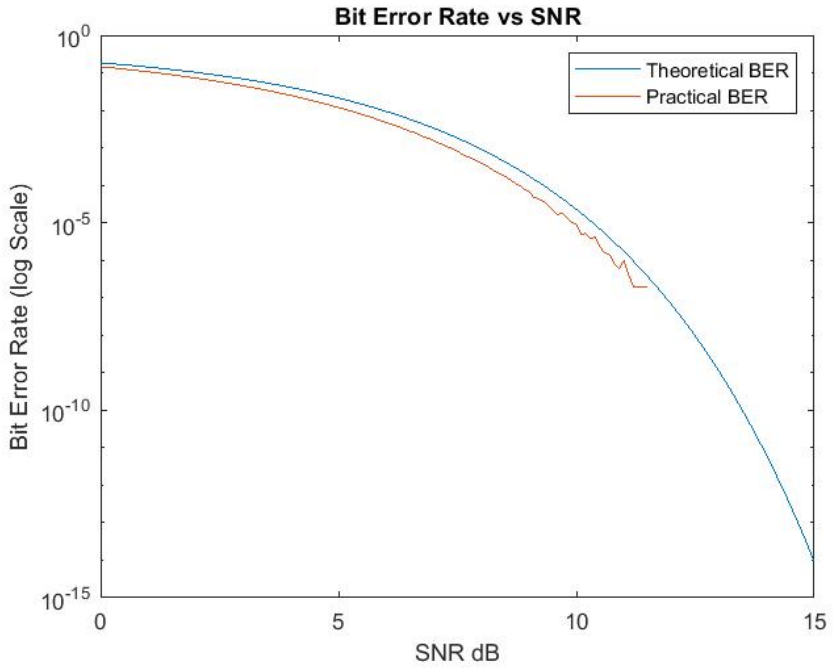
Probability of error for DBPSK is given by :

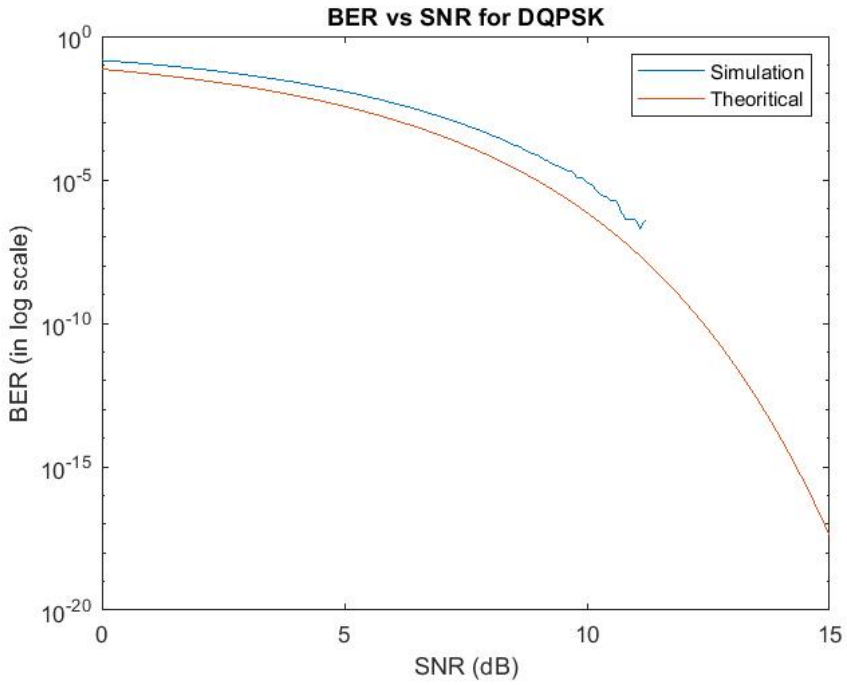
- $P_b = \frac{1}{2} * e^{\left(-\frac{E_b}{N_0}\right)}$
- $\frac{E_b}{N_0}$ is Signal to Noise ratio for DBPSK

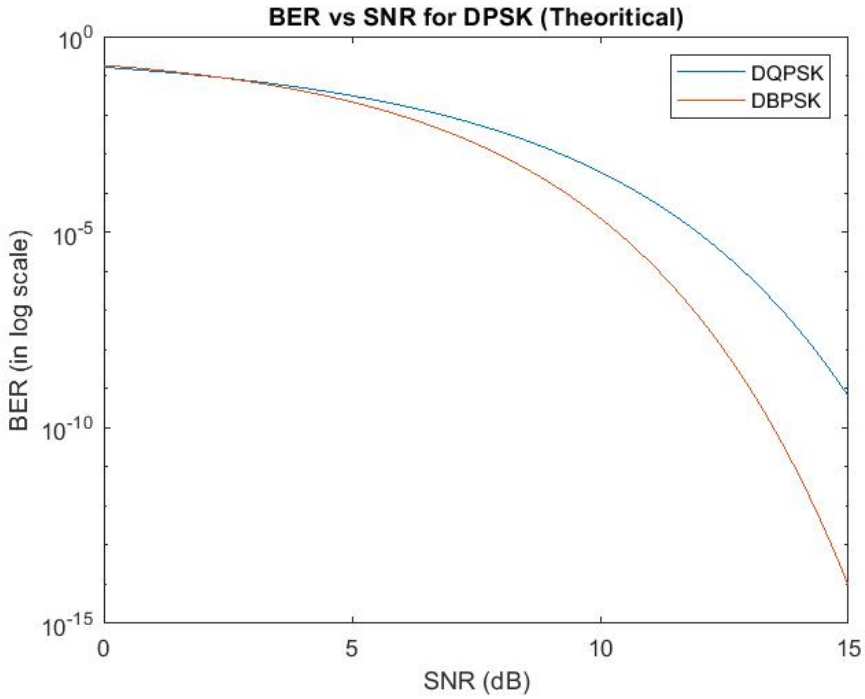
Probability of error for DQPSK is given by :

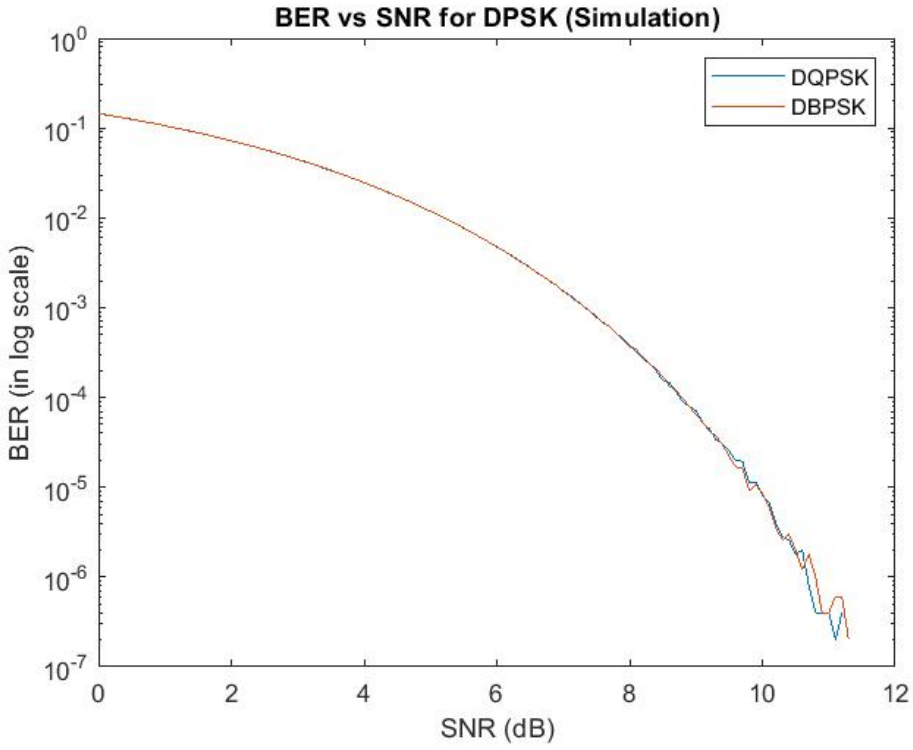
- $P_b = Q_1(a,b) - \frac{1}{2}\, I_Q(ab) * e^{-\frac{1}{2}(a^2+b^2)}$
- $a = \sqrt{\frac{2E_b}{N_o}\left(1 - \frac{1}{\sqrt{2}}\right)}$, $b = \sqrt{\frac{2E_b}{N_o}\left(1 + \frac{1}{\sqrt{2}}\right)}$
- $Q_1(a,b) =$ Marcum Q – Function
- $I_o(ab) =$ Modified Bessel Function
- $\frac{E_b}{N_0}$ is Signal to Noise ratio for DQPSK

Plots


Bit Error Rate vs SNR
Theoretical BER
Practical BER
Bit Error Rate (log Scale)
SNR dB
10^0
10^-5
10^-10
10^-15
0
5
10
15


BER vs SNR for DQPSK
Simulation
Theoritical
BER (in log scale)
SNR (dB)
10^0
10^-5
10^-10
10^-15
10^-20
0
5
10
15


BER vs SNR for DPSK (Theoritical)
DQPSK
DBPSK
BER (in log scale)
SNR (dB)
10^0
10^-5
10^-10
10^-15
0
5
10
15


BER vs SNR for DPSK (Simulation)
DQPSK
DBPSK
BER (in log scale)
SNR (dB)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
0
2
4
6
8
10
12

- For the plot we can observe that the BER obtained by simulation for DBPSK and DQPSK exactly overlap with each other.
- The theoretical results and simulated results are close to each other but does not match exactly for both DBPSK and DQPSK.
- The theoretical graphs are matching with that mentioned in the link
- I still cannot concur/recreate the theoretical graphs independently. Though I have still used the exact theoretical results presented in the link provided above.