Communications Lab

Experiment 6

180030036

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DBPSK and DQPSK Communication: Running an example

We generate a signal of randomly generated bits and perform DBPSK and DQPSK modulation. The modulation is done with Gray labelling for DQPSK.

We then encode the symbols using the differential encoding where we map every unique phase difference possible to a certain symbol.

We then add white Gaussian noise (using an SNR = 5 dBW) to our signal.

Then we perform demodulation based on distance boundaries (ML rule) between the symbols. We also decode using differential decoding technique. We get the following bit error rates in the two cases:

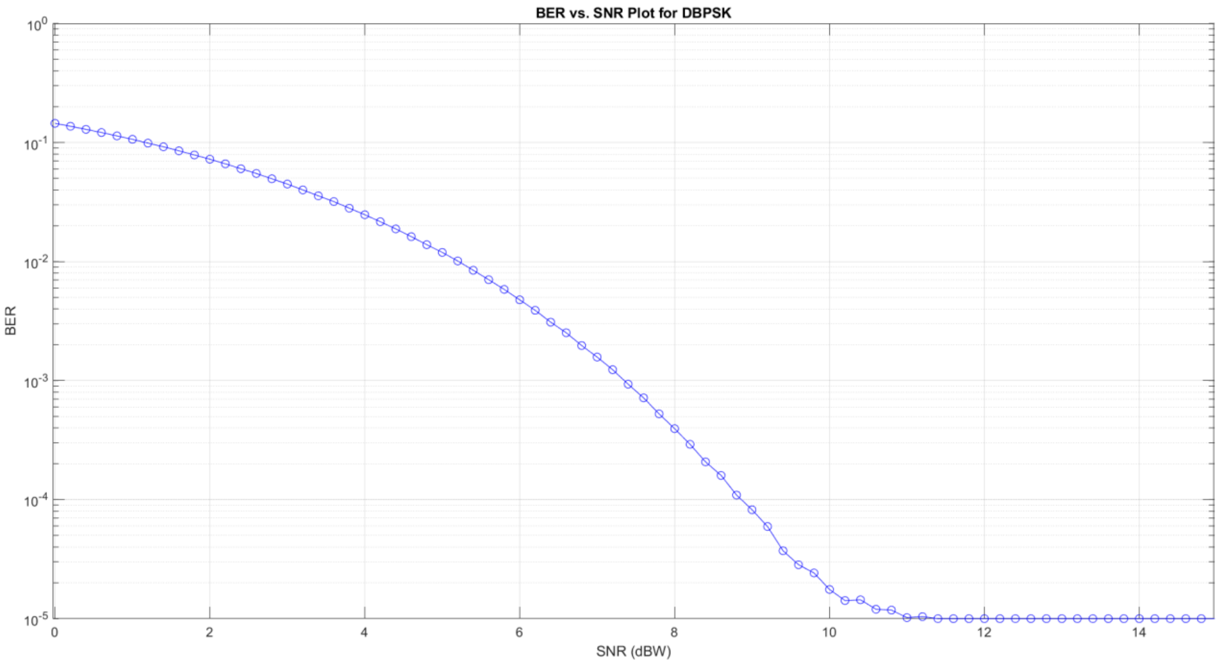
BER for DBPSK = 0.0135

BER for DQPSK = 0.0152

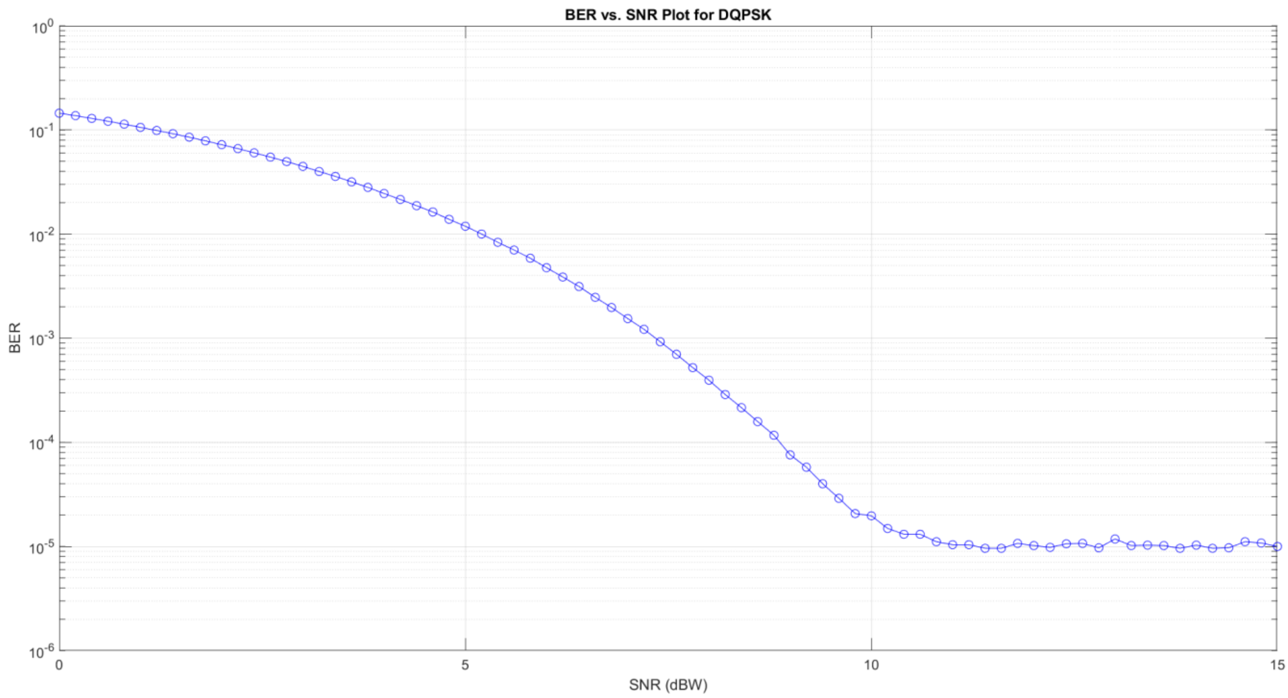
Bit Error Rate (BER) Calculation:

We run a randomly generated message signal of length 100000, for 100 iterations (we have a resolution of 10^-7) for each value of SNR from 0 to 15 dBW. The resulting bit error rate plots are as follows:

1. For DBPSK:



2. For DQPSK:



Theoretical Calculation of Error Probability:

Theoretical value of error probability for DBPSK communication system is calculated as follows:

$$SNR = \frac{E_b}{N_o}, \quad \sigma^2 = \frac{N_o}{2}$$

Where, σ^2 is the variance of the real and imaginary components of the AWGN.

We have, $E_b = 1$ for our choice of symbols. Therefore, standard deviation:

$$\sigma = \sqrt{\frac{1}{2SNR}}$$

The bit error rate is given as:

1. For DBPSK (approximate form):

$$P_e = 2Q\left(\sqrt{2SNR}\right)\left(1 - Q\left(\sqrt{2SNR}\right)\right)$$

2. For DQPSK: We were unable to derive an expression.

The graph of theoretical and practical BER vs. SNR for the case of DBPSK is as follows. We see that both the curves match well.