EE 708 : Course Project

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Project Report

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I. Introduction

In this project, we demonstrate the usage of channel coding with a random codebook. We first proceed with the codebook generation using symbols from a Gaussian distribution with a gaussian additive noise as the channel model. We employ the technique of minimum distance decoding in the decoder. Next, a similar scheme with codebook generation as QPSK symbols is demonstrated with a minimum distance decoder. The corresponding bit error rate (BER) for these two techniques is compared. The results and discussions of these techniques comprise the sections of this report. Also, these are implemented in GNURadio by making custom block, the code-frame for which is made available in the GitHub repository mentioned towards the end of the report.

II. Implementation

Our custom block in both QPSK and Gaussian contains the python code which builds the random codebook inside itself (the value of M,N is hard-coded inside the block). The purpose of this block thus would be to take an input data stream and output the decode stream after adding the noise (gaussian) within itself.

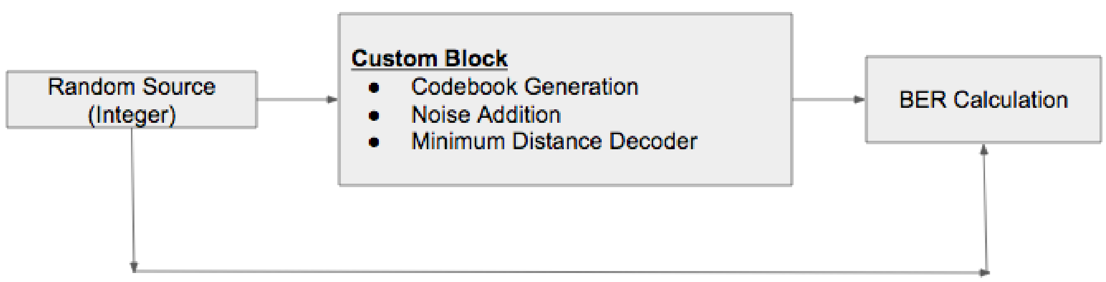

Figure 1: Block diagram for implemented scheme

The codebook is generated for different values of P inside this code, thus enabling us to calculate the error rate for different values of P. To generate the BER plot (Error vs Power) as desired, we iterate over power values in a particular range inside the code. The error values for an input chunk are averaged for a number of runs for a particular value of P. This provides us with the output vector of Error Rates indexed over the changing power P.

III. Gaussian Codebook

The BER for different values of M is shown below:

1. M=8

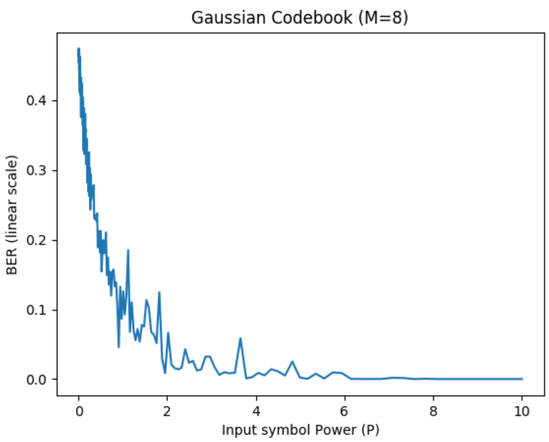

Figure 2: M=8, Gaussian, Linear Scale

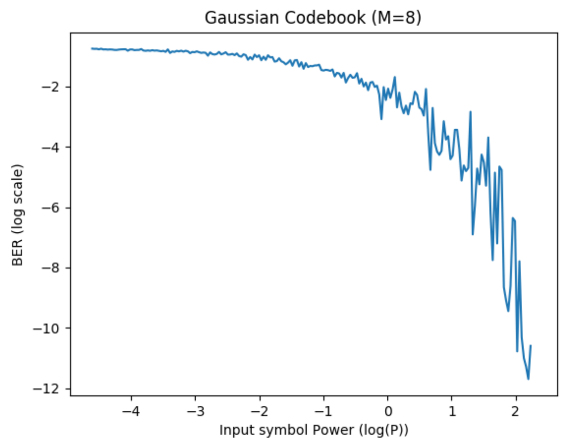

Figure 3: M=8, Gaussian, Log Scale

2. M=20

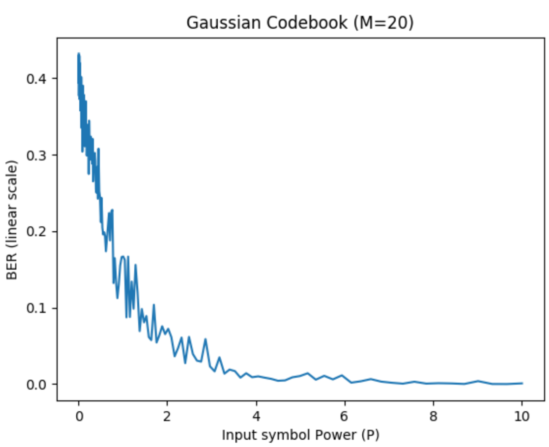

Figure 4: M=20, Gaussian, Linear Scale

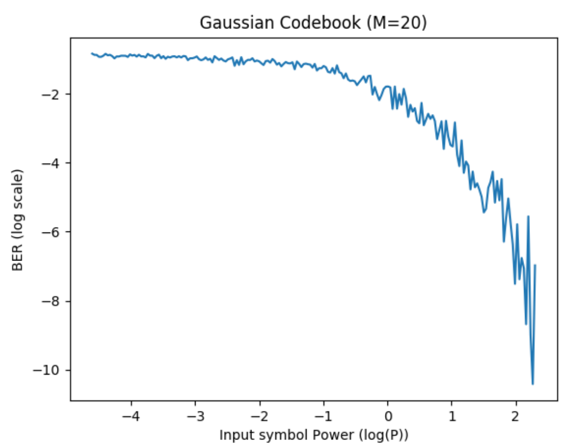

Figure 5: M=20, Gaussian, Log Scale

IV. QPSK Codebook

The BER for different values of M is shown below:

1. M=8

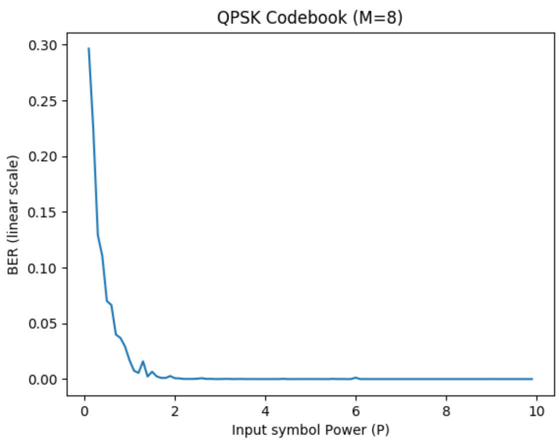

Figure 6: M=8, QPSK, Linear Scale

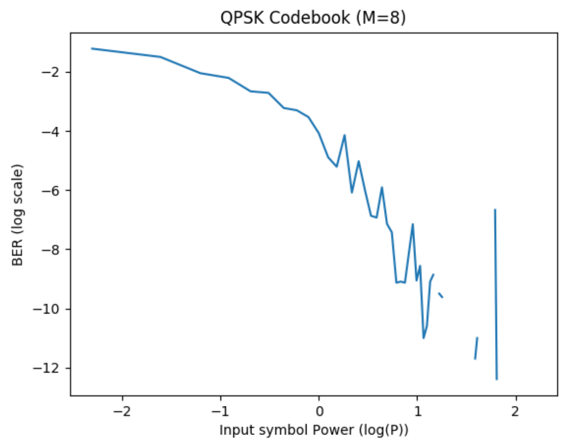

Figure 7: M=8, QPSK, Log Scale

2. M=20

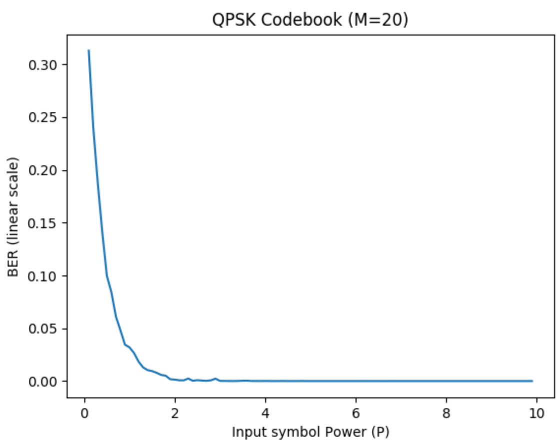

Figure 8: M=20, QPSK, Linear Scale

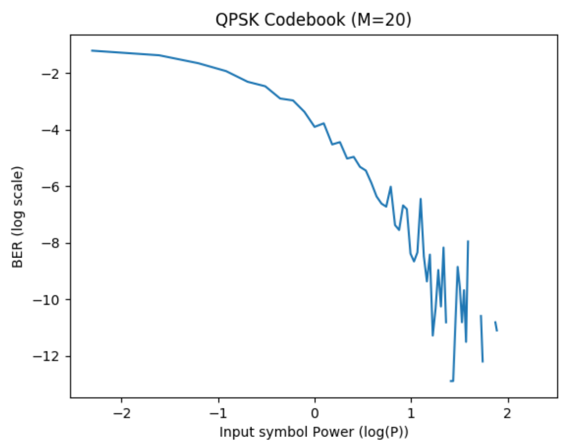

Figure 9: M=20, QPSK, Log Scale

V. Comparison of Schemes

Juxtaposing the plots on each other can help us observe the difference between the two schemes:

1. Different values of M (M=8 vs M=20)

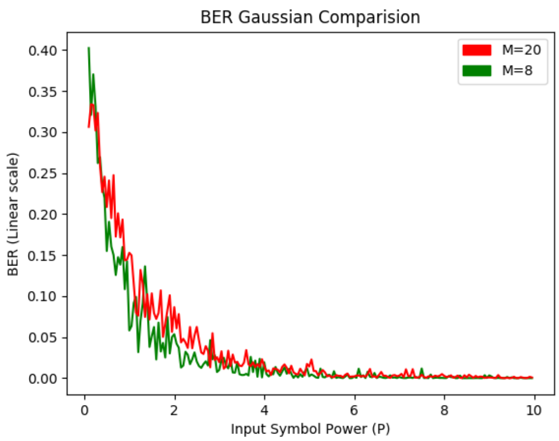

Figure 10: BER Gaussian, Linear Scale

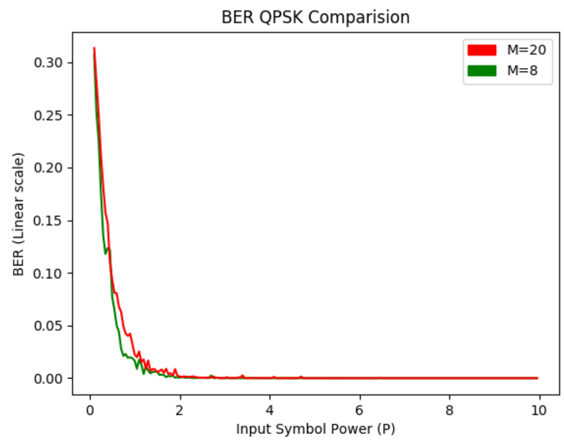

Figure 11: BER QPSK, Linear Scale

2. Difference within Schemes (Gaussian vs QPSK)

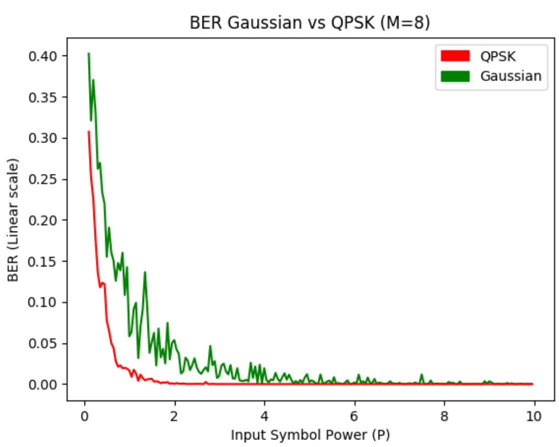

Figure 12: BER Gaussian vs QPSK, M=8

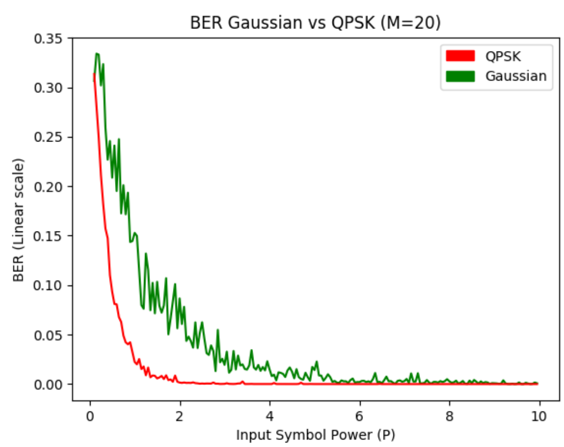

Figure 13: BER Gaussian vs QPSK, M=20