UCSD MAS WES268A - Lab 5 Report

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Contents

1 Part 1: Coding Gain for Linear Block Codes

3. - For a range of E_b/N_0 values from 0dB to 10dB (i.e. eleven 1dB steps), measure the Bit Error-Rate for the following "codes":

a. Uncoded

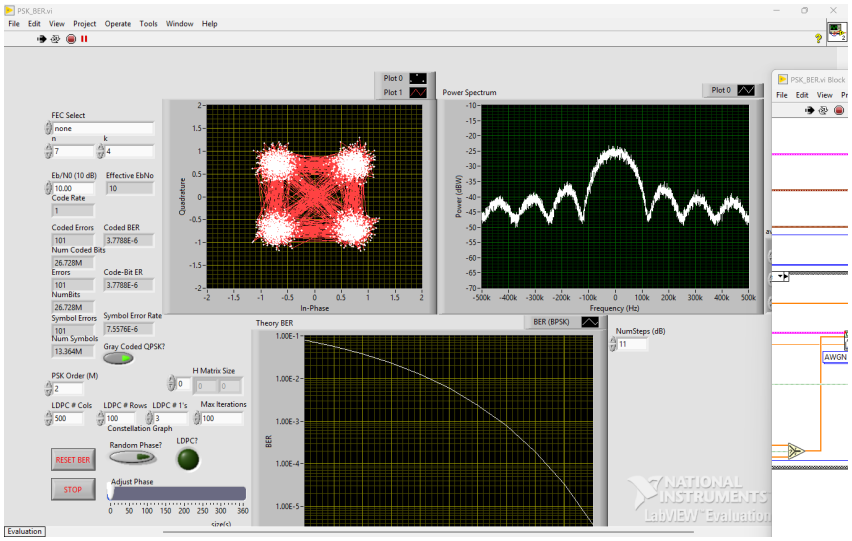

Figure 1: 1.3.a - Uncoded Bit Error Rates under AWGN

b. n-Repetition(3,1,3)

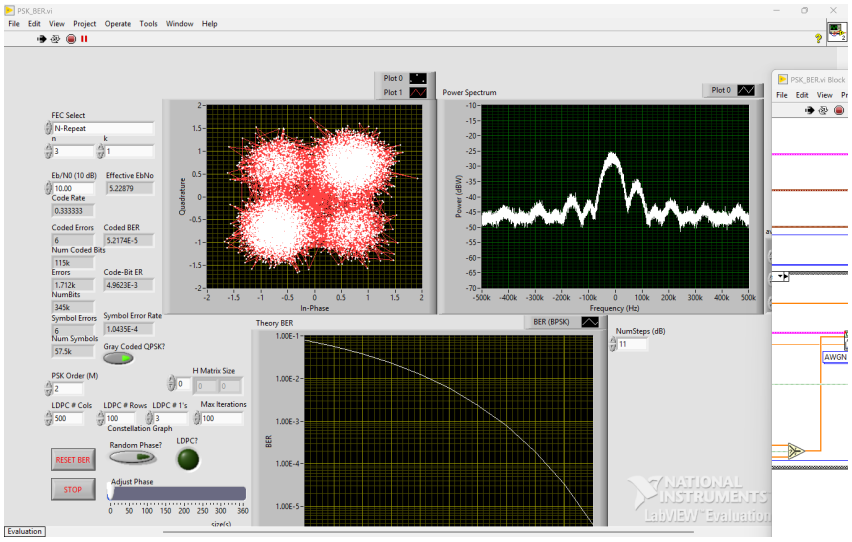

Figure 2: 1.3.b - n-Repetition(3,1,3) Bit Error Rates under AWGN

c. Hamming (7,4,3)

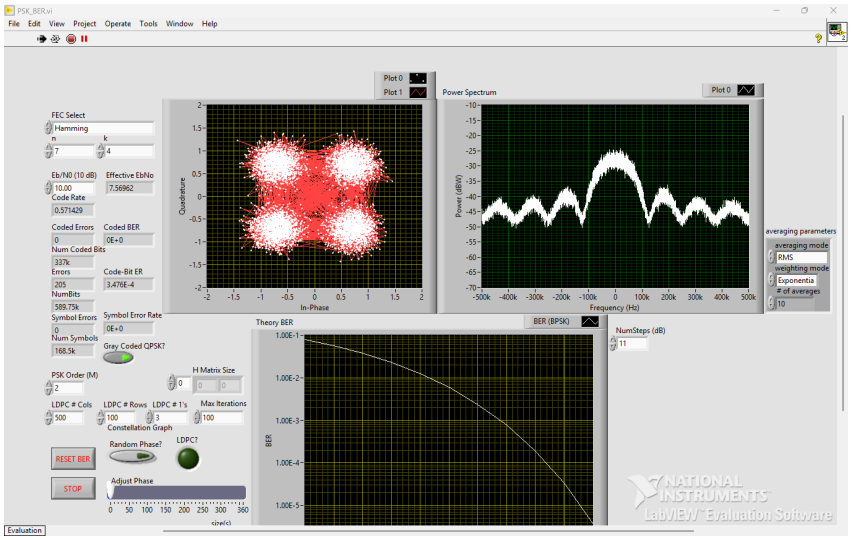

Figure 3: 1.3.c - Hamming (7,4,3) Bit Error Rates under AWGN

d. Golay (24,12,8)

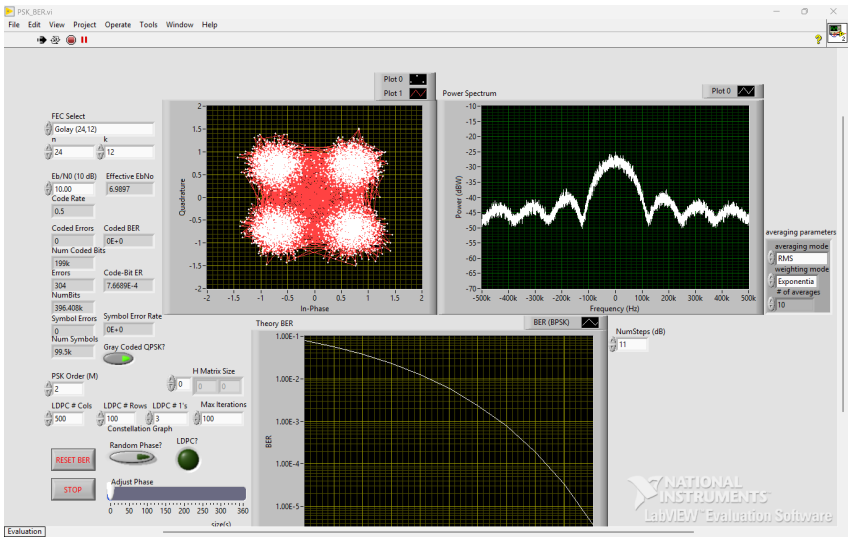

Figure 4: 1.3.d - Golay (24,12,8) Bit Error Rates under AWGN

2 Part 2: Low Density Parity Check Codes

4. - For a range of E_b/N_0 values from 0dB to 10dB (i.e. eleven 1dB steps), measure the Bit Error-Rate for the following ”codes”:

a. LDPC

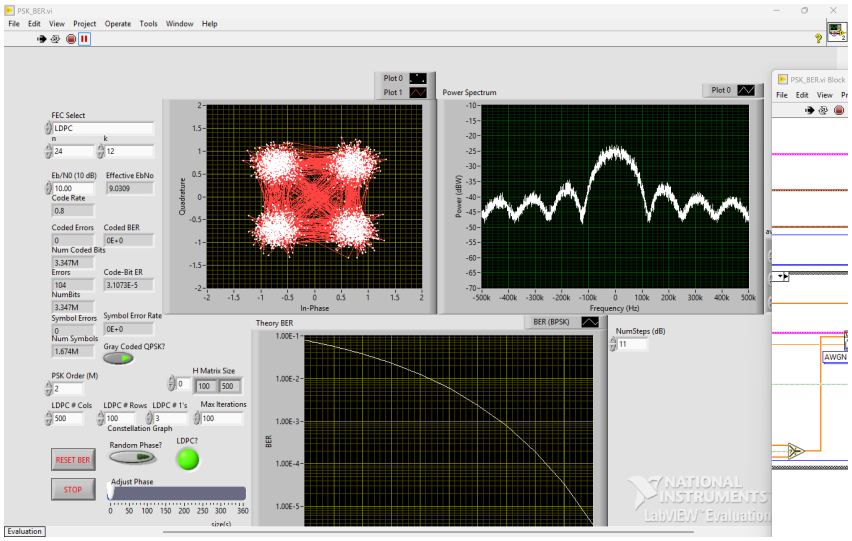

Figure 5: 2.4.a - LDPC Bit Error Rates under AWGN

5. - Repeat step 4 for a range of values of *Max Iterations*. Based on your results, how many iterations *should* we use for this particular LDPC code? Are you able to observe the point of diminshing returns?

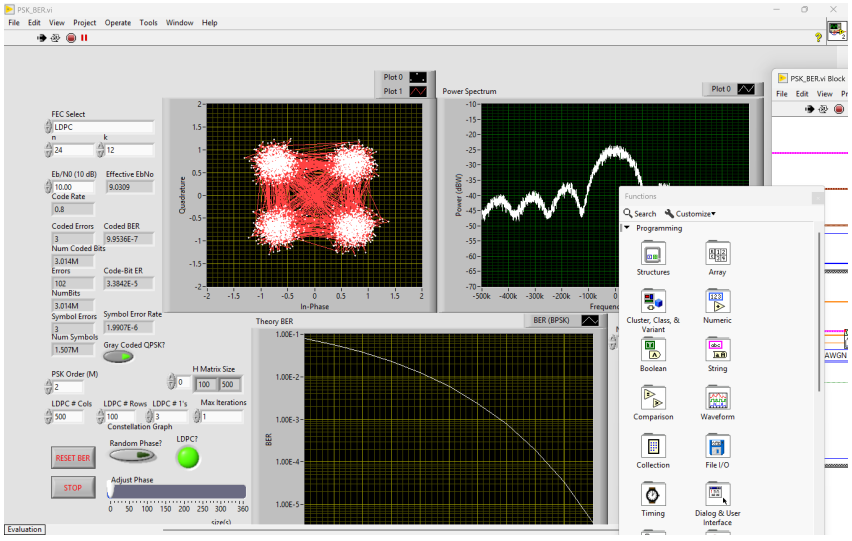

Figure 6: 2.5.1 - LDPC Bit Error Rates under AWGN, Max Iterations 1

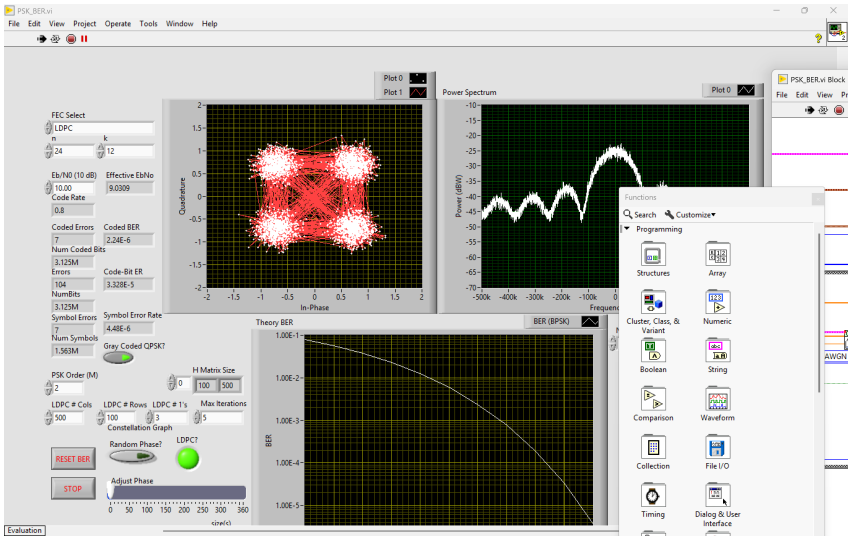

Figure 7: 2.5.2 - LDPC Bit Error Rates under AWGN, Max Iterations 5

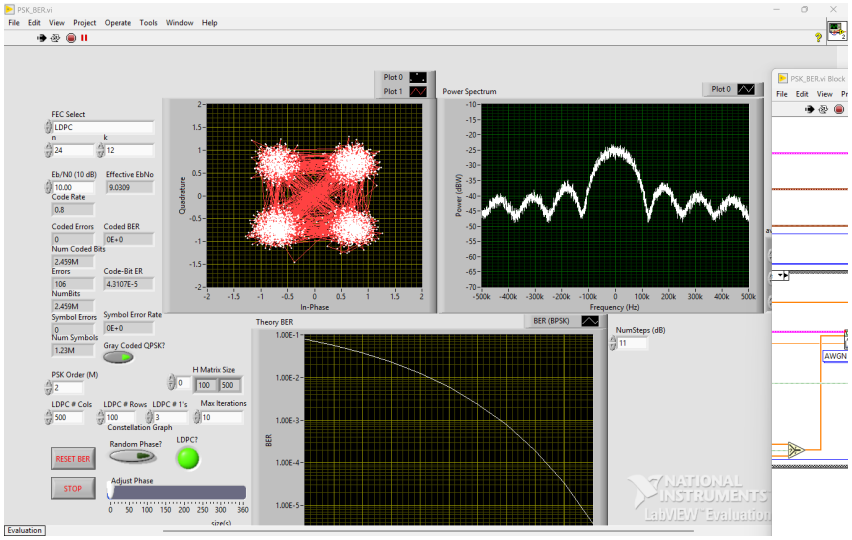

Figure 8: 2.5.3 - LDPC Bit Error Rates under AWGN, Max Iterations 10

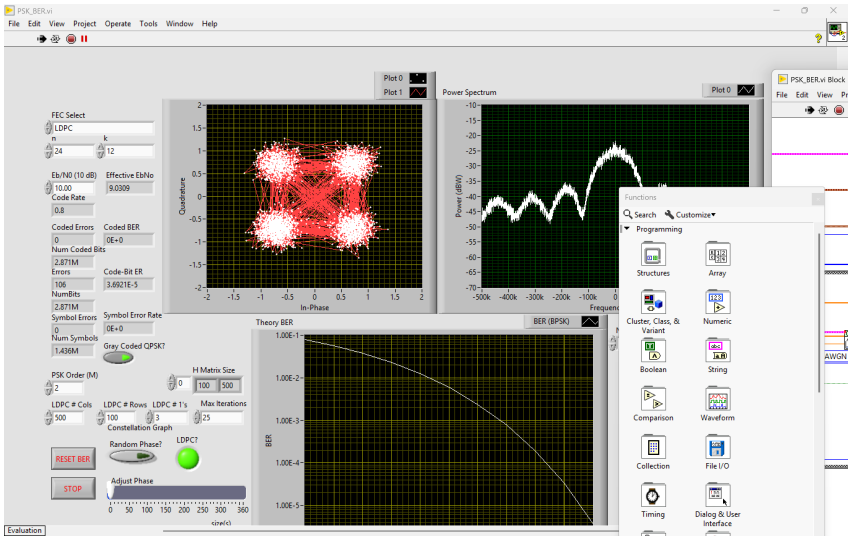

Figure 9: 2.5.4 - LDPC Bit Error Rates under AWGN, Max Iterations 25

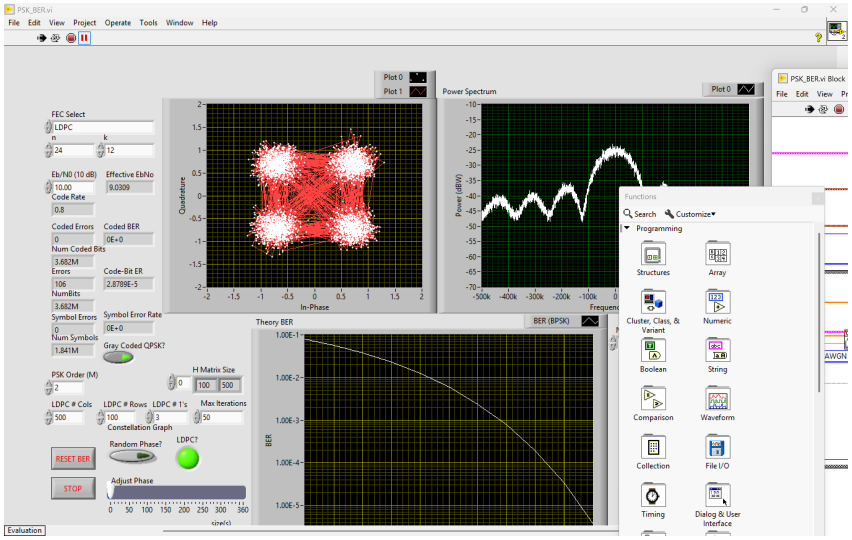

Figure 10: 2.5.5 - LDPC Bit Error Rates under AWGN, Max Iterations 50

Based on our testing, we can see that the Max Iterations appears to have diminishing returns past 10 iterations as the number of coded errors become less frequent. We note that the number of errors as time goes to infinity cannot definitively be 0, as we have only collected measurements after one minute.

3 Part 3: Higher Order Modulation and Gray Coding

2. - For a range of E_b/N_0 values from 0dB to 10dB (i.e. eleven 1dB steps), measure the Bit Error-Rate for the following settings:

a. "Gray Coded" QPSK

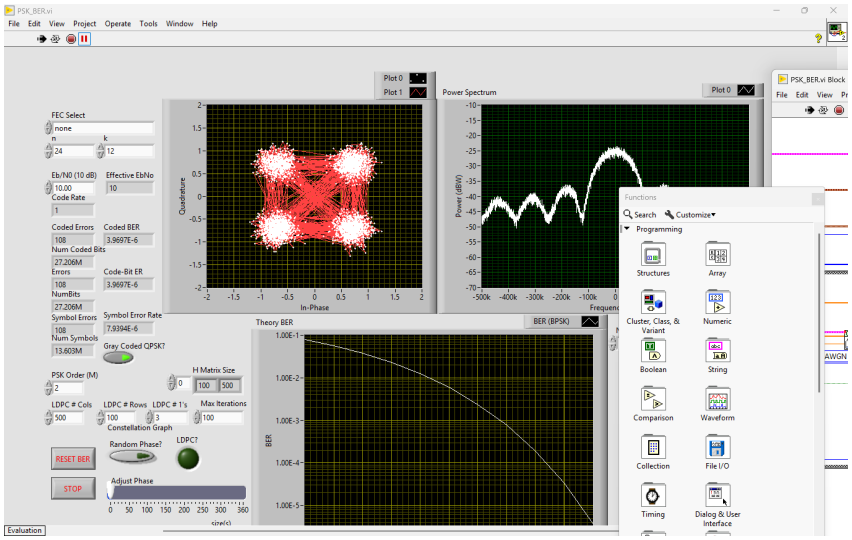

Figure 11: 3.2.a - "Gray Coded" QPSK Bit Error Rates under AWGN

b. "Non-Gray Coded" QPSK

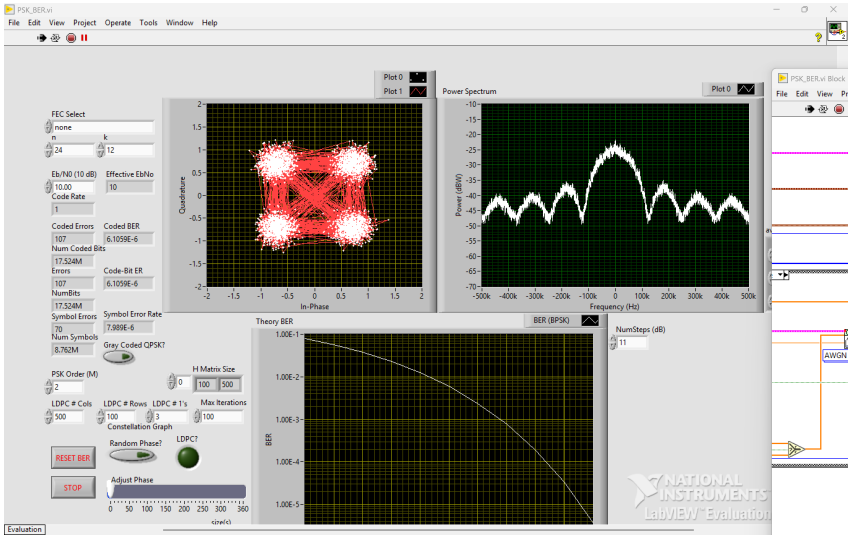

Figure 12: 3.2.b - "Non-Gray Coded" QPSK Bit Error Rates under AWGN

4 Part 4: Post Lab

1. - On the same graph, plot the Uncoded Bit Error Rate and Coded Bit Error Rate for the n-Repetition (3,1) and Hamming (7,4), and Golay (24,12) codes.
n-Repetition (3,1)
Hamming (7,4)
Golay (24,12)
Give an explanation for the cross-over point of the uncoded and coded ber curves.
2. - On the same graph, plot the Uncoded Bit Error Rate and Coded Bit Error Rate for the LDPC code for range of values you used for *Max Iterations*. Are there any changes in coding gain for different values of *Max Iterations*?
3. - On the same graph, plot the Uncoded Bit Error Rate for QPSK with both ”gray” and ”non gray” codes. Explain the difference between the two curves.
4. - What is the measured coding gain for the error correction codes from parts 1? Which error correction code is better? Why?
5. - Compare the measured coding gains from part 1 to the expression for asymptotic coding gain G, where

$$G \approx R_c(t+1)$$

$$t = \text{floor}(\frac{d_{min}-1}{2})$$

Do they match? Why or why not?
6. - What are the consequences of using an _even value of n for an n-repetition (n,1) code?

5 Part 5: Additional Questions

1. - Consider the 8-PSK constellation given by symbol values below:

s_0	s_1	s_2	s_3	s_4	s_5	s_6	s_7
1	$e^{j\frac{2\pi}{8}}$	$e^{j\frac{4\pi}{8}}$	$e^{j\frac{6\pi}{8}}$	$e^{j\frac{8\pi}{8}}$	$e^{j\frac{10\pi}{8}}$	$e^{j\frac{12\pi}{8}}$	$e^{j\frac{14\pi}{8}}$

Figure 3.1: 8-PSK Constellation Values

Can you construct a gray-coded symbol mapper table for this constellation? Justify your answer (i.e. if it's possible, create the symbol mapping table, otherwise explain why it's not possible).

2. - Consider the 8-QAM constellation given by symbol values below:

s_0	s_1	s_2	s_3	s_4	s_5	s_6	s_7
$-3+3j$	$-3-j$	$-1+j$	$-1-3j$	$1+3j$	$1-j$	$3+j$	$3-3j$

Figure 3.2: 8-QAM Constellation Values

Can you construct a gray-coded symbol mapper table for this constellation? Justify your answer (i.e. if it's possible, create the symbol mapping table, otherwise explain why it's not possible)

feelsgoodman