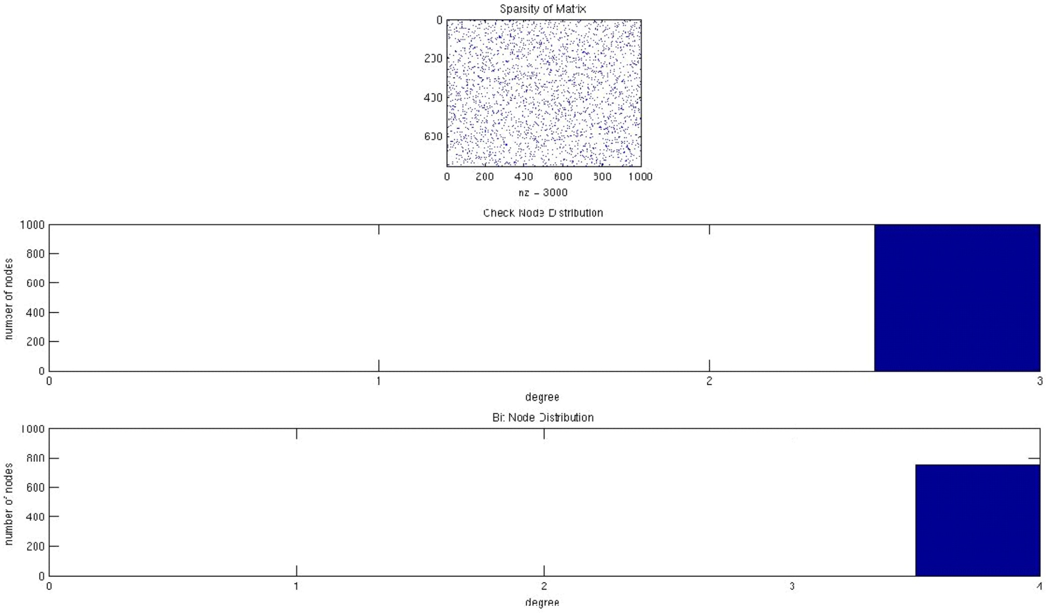
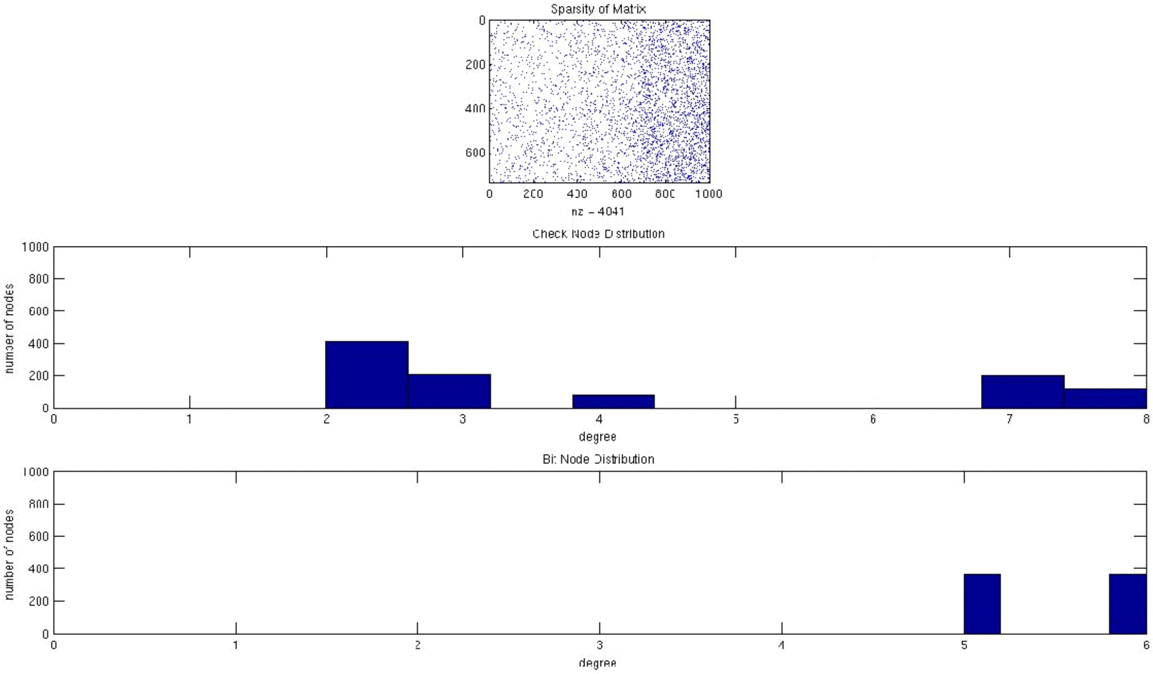
1. Generating LDPC codes (For regular and irregular)

First subplot shows the sparsity of the H matrix. Histogram plots on the number of ones in rows and columns for regular (3,4) and irregular (8,6) (lambda=[0 0.409 0.202 0.0768 0 0 0.1971 0.1151] and rho=[0 0 0 0 0.5 0.5]) codes show their degree distributions.

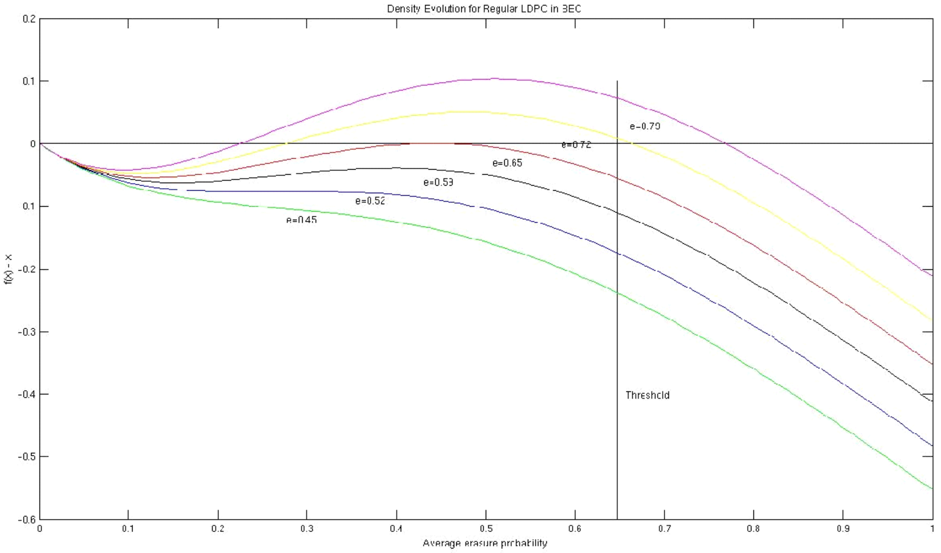
It was also verified that there are no girth 4 cycles in the generation of H.

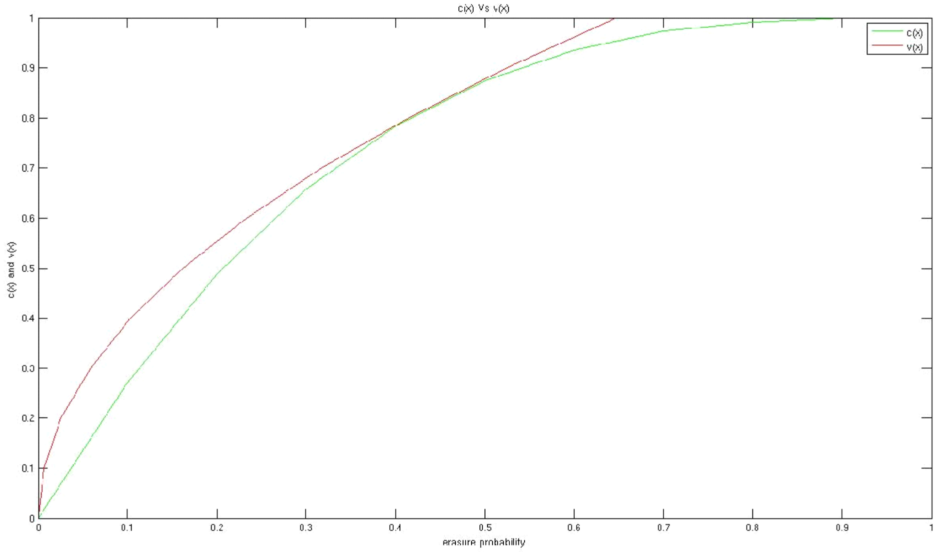


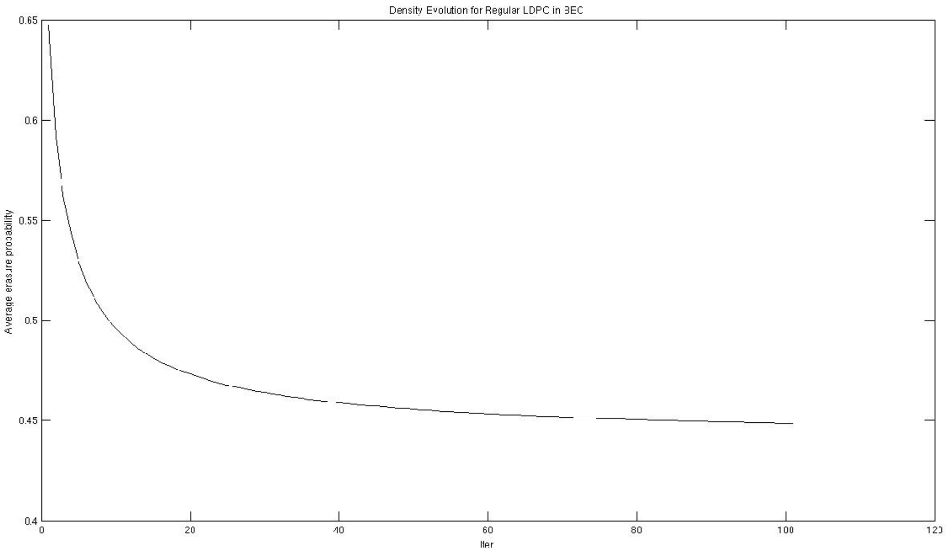


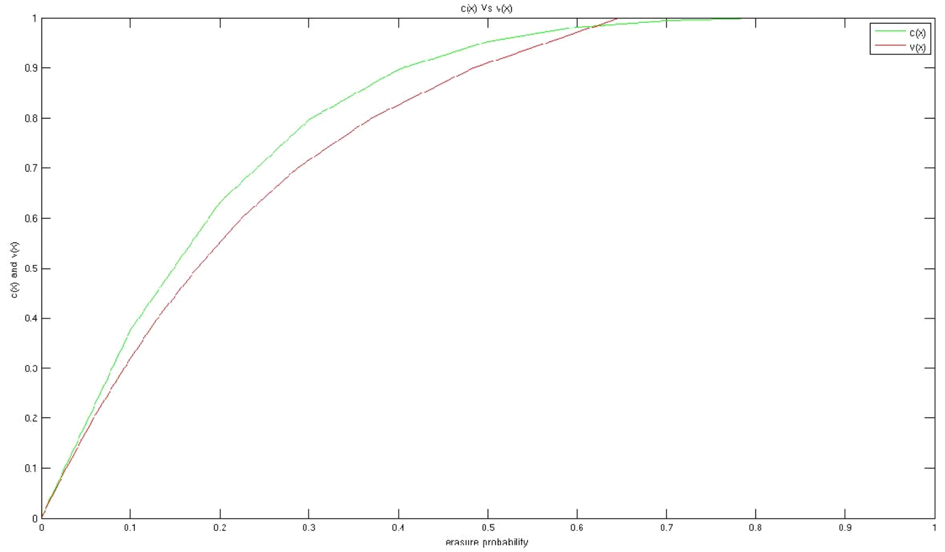
2. **Density Evolution for BEC (regular and irregular LDPC)**

f(x)-x are shown for the 2 codes generated above (regular first) and an EXIT chart like plot with c(x) and v(x). The behaviour converges to theoretically expected values, viz, epsilon=.6474 for (3,4) Ldpc code and about 0.5 for the irregular (8,6) code.





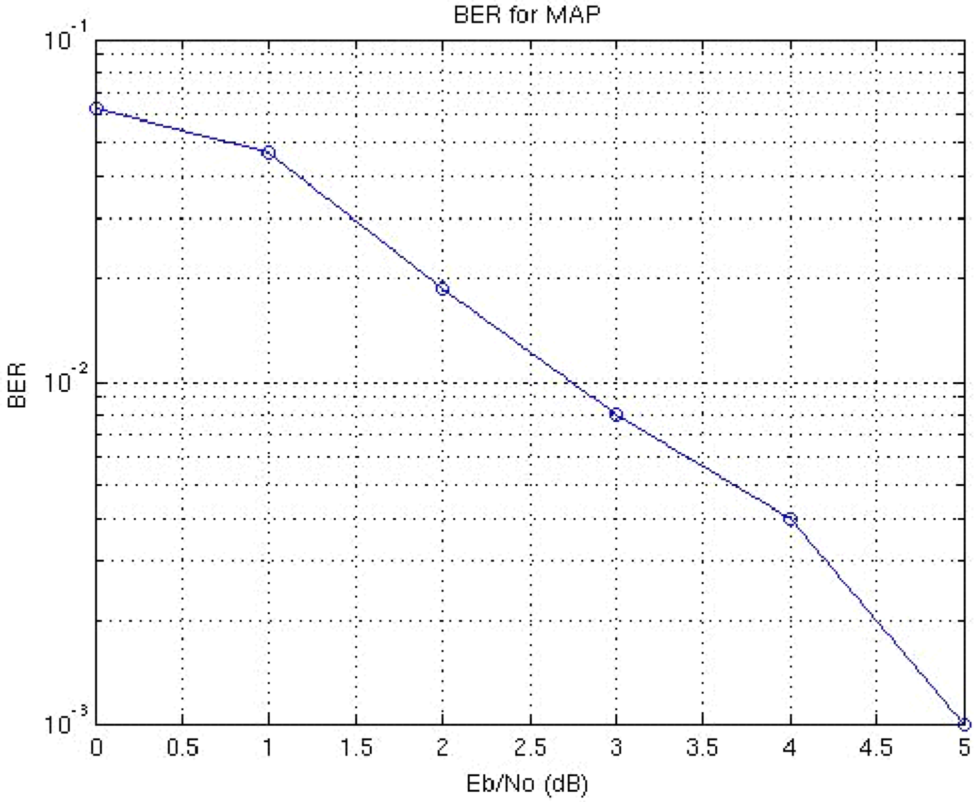




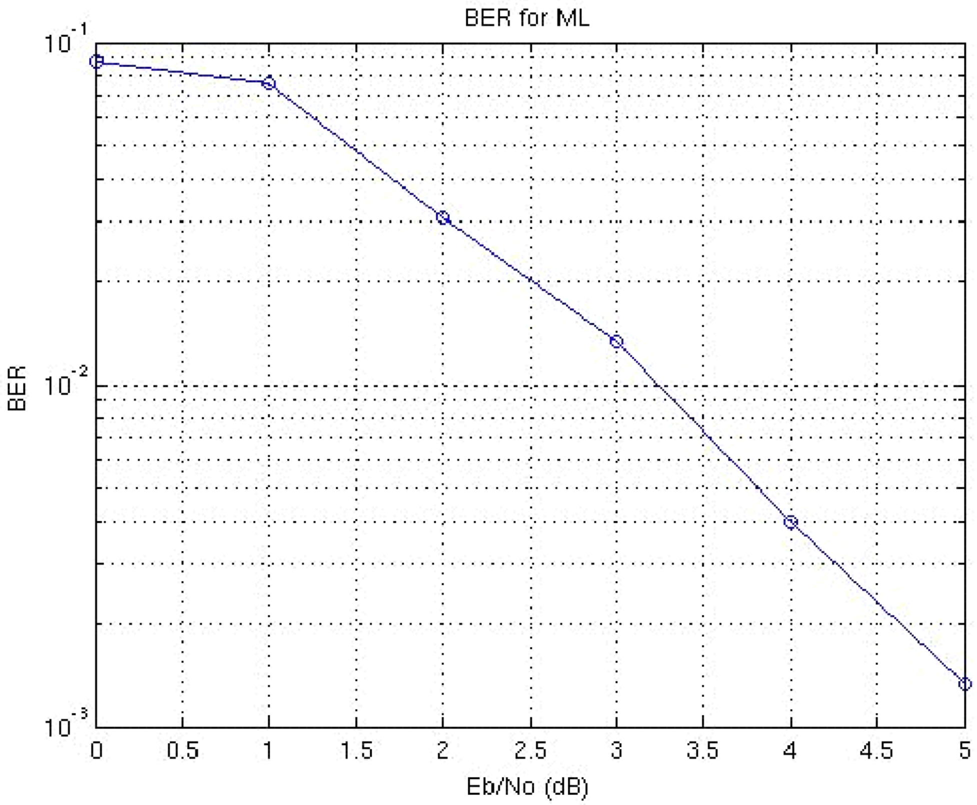
3. ML and MAP decoding of Linear Block Codes

The programs were run on (15,11) Hamming codes as sizes beyond that are unwieldy in this method. The program will work for any LBC.

MAP gives slightly better results than ML.



BER for MAP
BER
Eb/No (dB)
10^{-1}
10^{-2}
10^{-3}
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5



I. LDPC Decoders

Observations were made over several n values- 200,1200 and 4000. For the larger codes, the behaviour is very close to capacity.

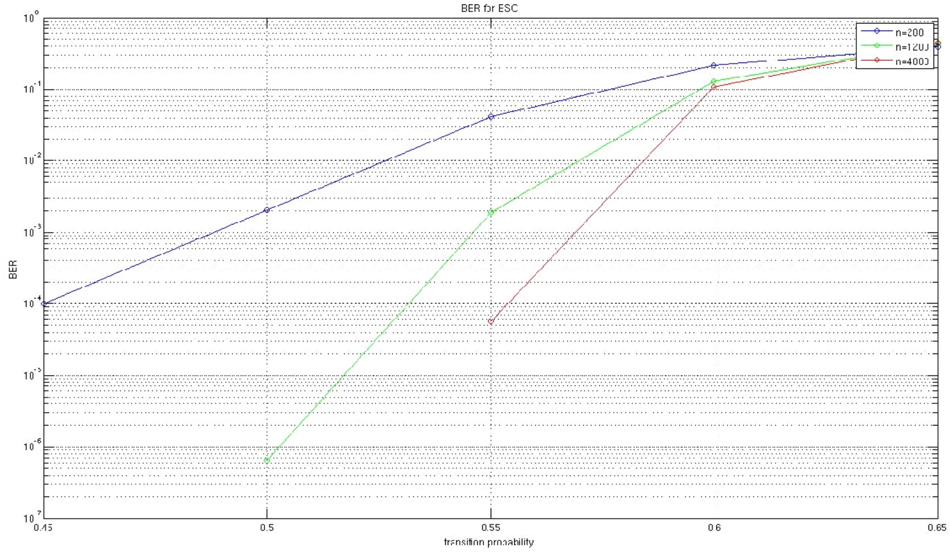
The non existent values indicate that the FER or BER was zero inspite of running the decoder through several thousand iterations.

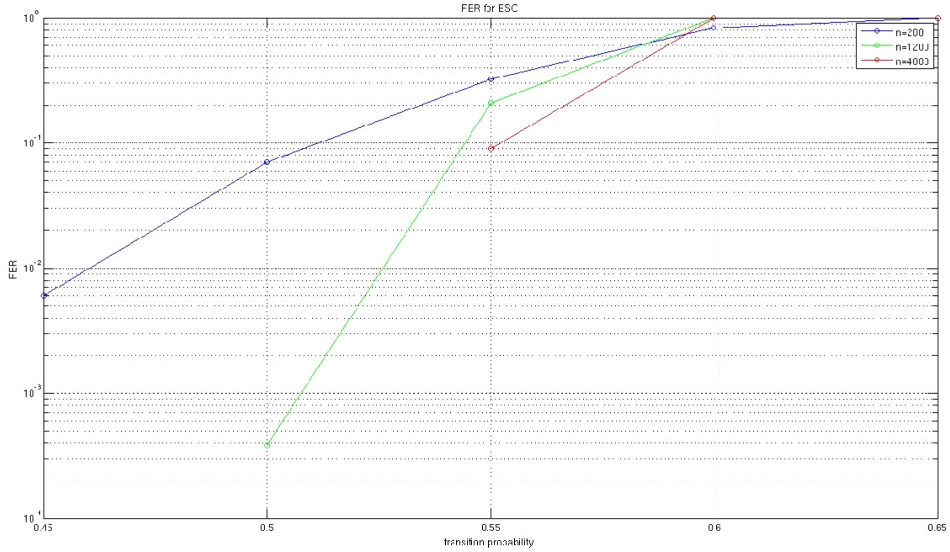
Tests for all codes were on (3,4) regular codes. The decoder is the same for Irregular codes also, and the performance goes closer to capacity.

At the thresholds on the respective channel parameters we see all 3 codes bunching up together.

4. LDPC Decoder over BEC

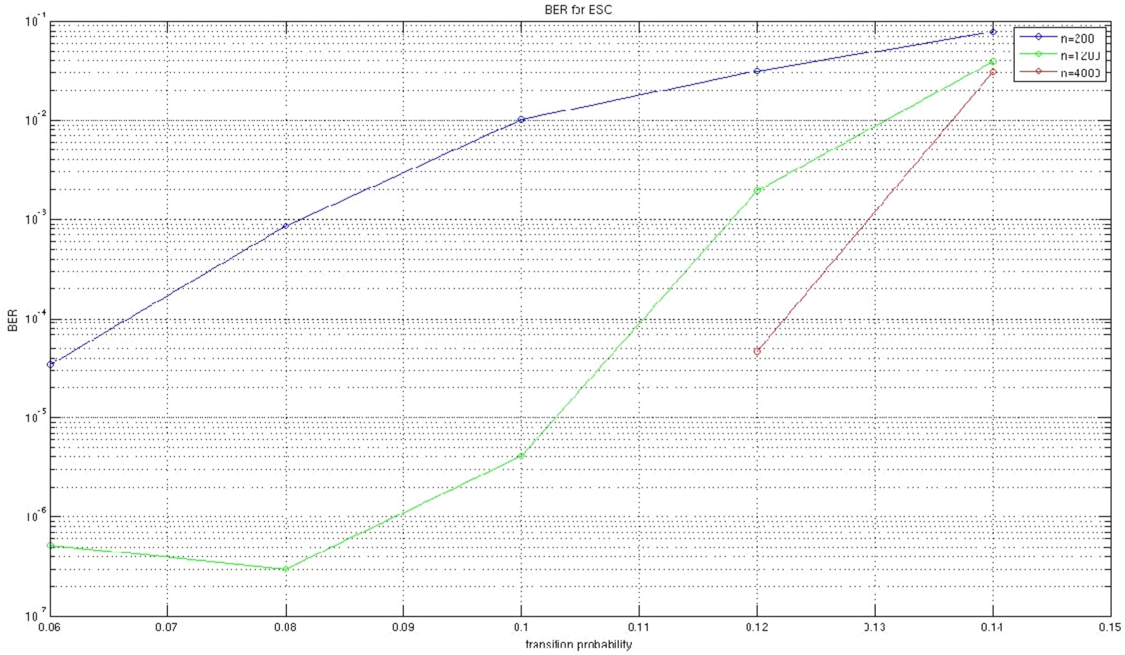
Threshold: epsilon = 0.6474.

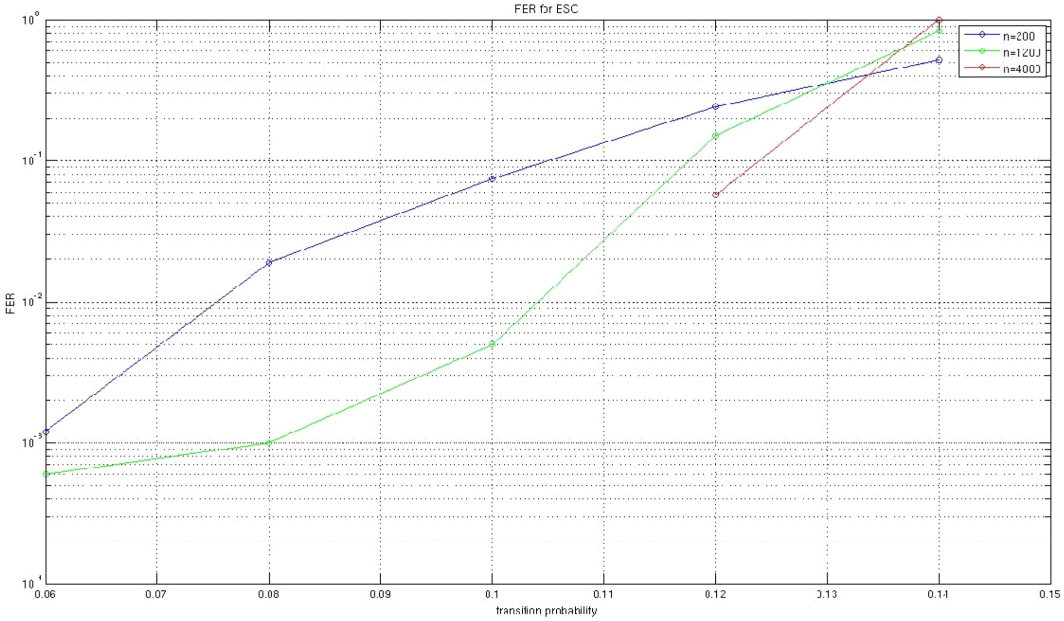




5. LDPC Decoder over BSC

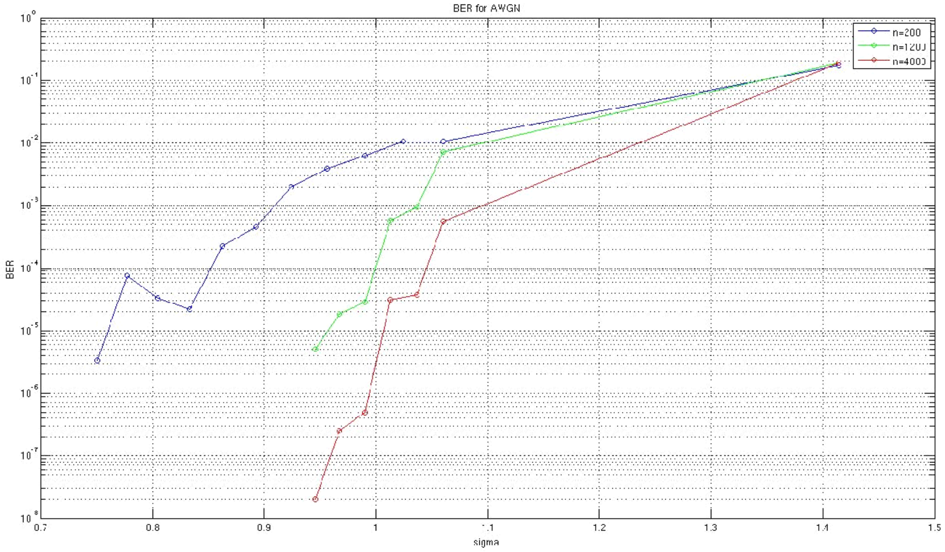
Threshold: transition probability = 0.1

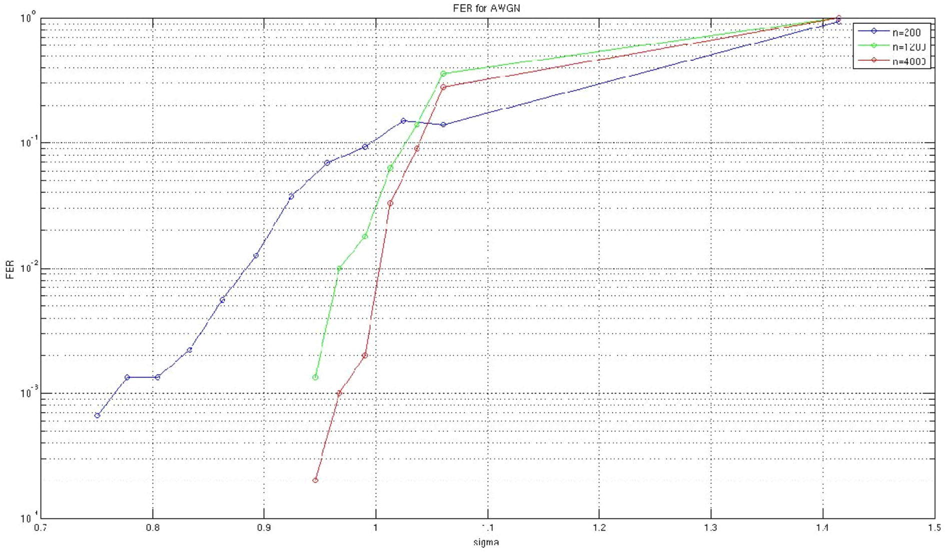




6. LDPC Decoder over BI-AWGN

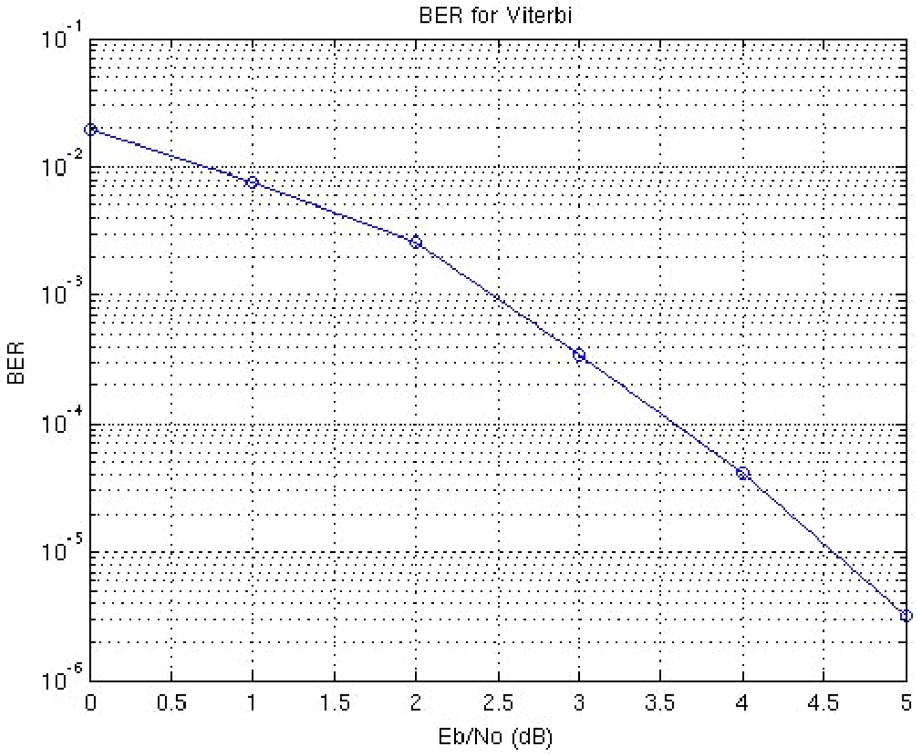
Threshold: sigma = 1.267

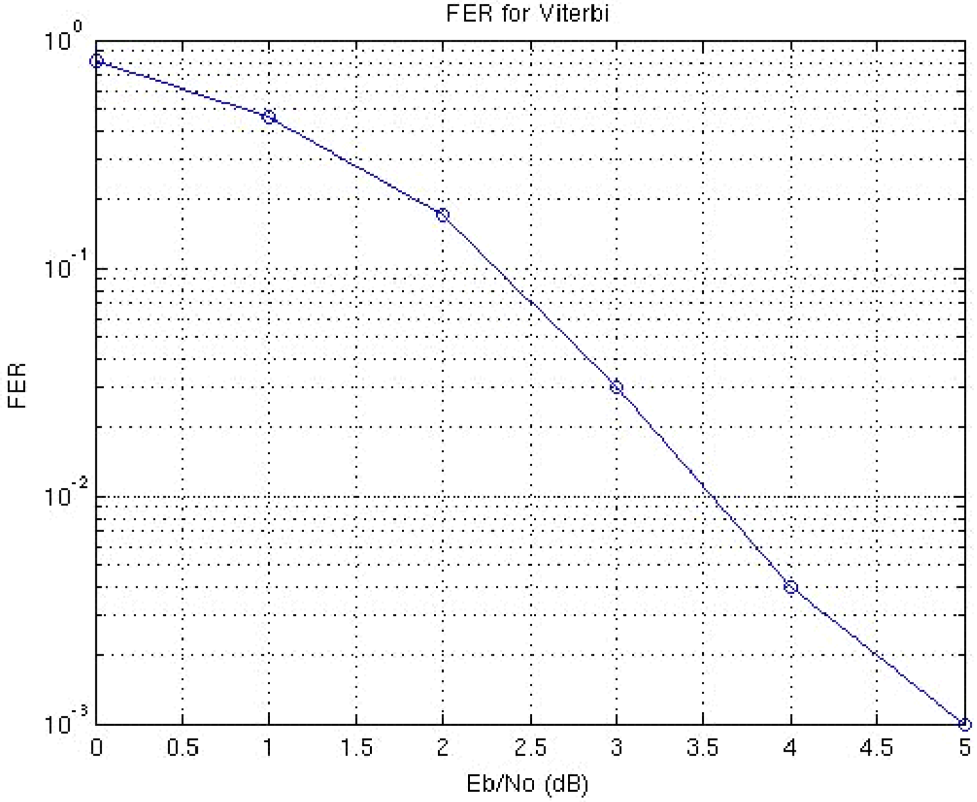




7. Viterbi Decoding over BI-AWGN

A generalized algorithm for decoding convolution codes of any rate and any number of memory elements was implemented. It was tested on a Rate=1/3 code with 3 memory elements and 8 states.


BER for Viterbi
BER
Eb/No (dB)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


FER for Viterbi
FER
Eb/No (dB)
10^{0}
10^{-1}
10^{-2}
10^{-3}
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5