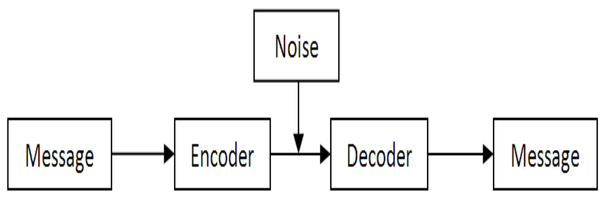
Low-Density Parity-Check (LDPC) Code

Introduction:

An LDPC code takes a message, encodes it, and after being exposed to noise by traveling through a noisy channel, it is able to decode and retrieve the original message.



Encoder:

To encode one must perform matrix multiplication. You multiply the message by the encoding matrix, G. G is composed by an identity and a parity check [I | P]. The identity repeats the message and makes it simple to recover the message after decoding. The parity check is what gives us the ability to correct errors.

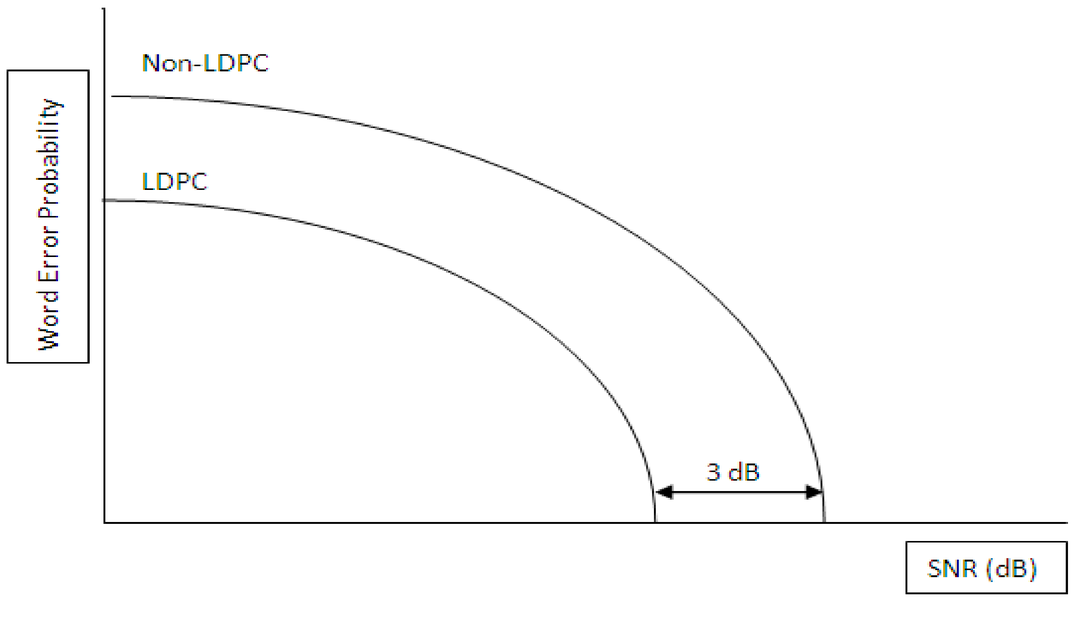
Decoder:

The decoding can be broken up into three parts:

1) Computing initial probabilities: the received codeword is no longer a bit stream but rather a floating point number (1.2 or 0.2) due to the addition of noise. Using these values we can derive the probability of each bit being a 1 or 0.
2) Syndrome check: a decision is made of whether the bit is a 1 or 0 based on the higher probability. The codeword is multiplied by the transpose of H, where H=[P(transposed)|I]. If the result is a zero vector, then the codeword is valid. The message is the first string of bits equal to the message length.
3) Iterative decoding: updates the probabilities by taking the probabilities from the initial and the H matrix from the syndrome check. The process goes back to step 2.

Conclusion:

An LDPC code's ability to retrieve a message through noise faster than other coding methods, such as turbo looping, makes it ideal for practical applications. Although at the moment we do not have our data fully gathered we do have an idea of the results we expect to obtain. When comparing an LDPC to a non-LDPC code the word error probability should be much higher for a given signal-to-noise ratio (SNR). Overall we expect an improvement of about 3dB and you can see a sample of plot of our expected results below.



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