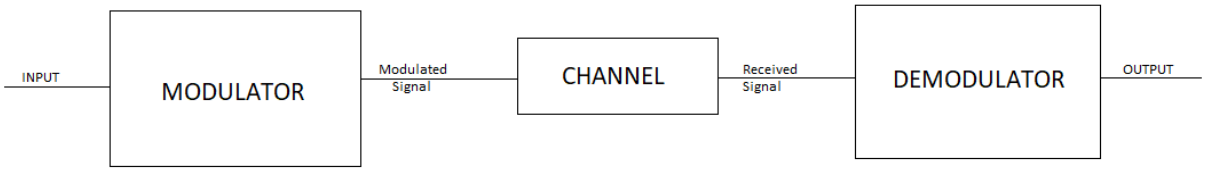
INTRODUCTION TO COMMUNICATION
PROJECT COMPONENT 1

Problem Statement :

To design a simulator for a **Morse Code** communication system Using BPSK Modulation & Demodulation.

Approach :

Basic overview of the simulated System:

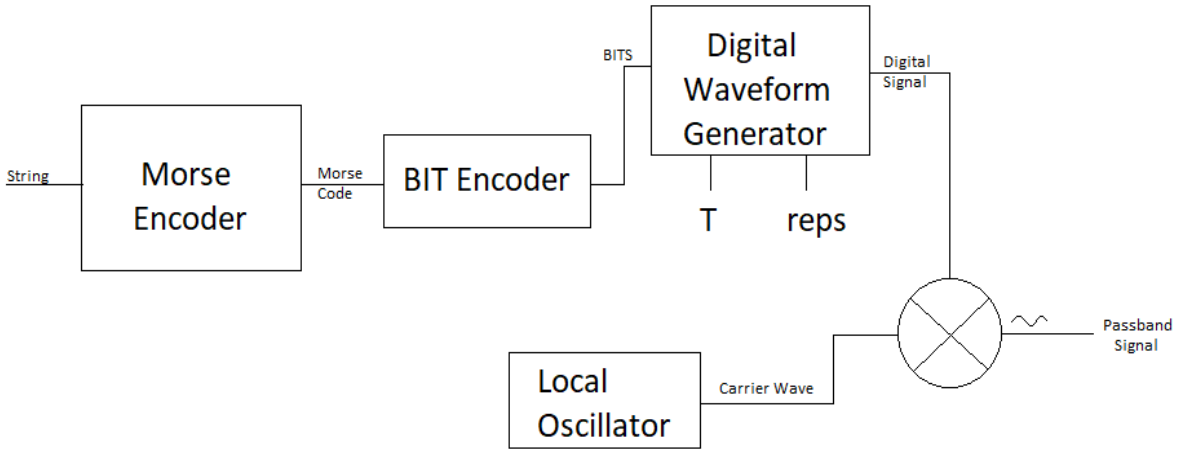


*The Input & Output are strings of alphanumeric Characters.

In Depth View of each component of the System:

1) Modulator :

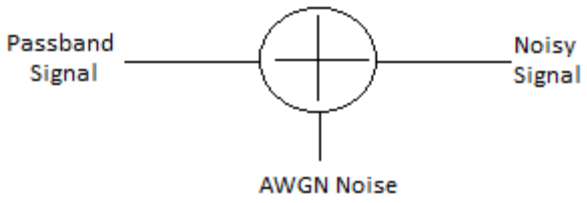
Block Diagram.



- Morse encoder takes in a string input and converts it into morse code. This block is simulated by *string2morse.m* .
- Bit Encoder Converts the Morse Code into Bits. This block is simulated by *morse2bit.m* .
- Digital Waveform Generator converts the bits into BPSK symbols and then performs repetition operation.
  Hence for example, a bit stream 1010 is converted to 11111000001111100000 assuming reps = 5.
  This Block is simulated by *symbolrep.m*
- Final Output is the passband signal.

2) Channel :

Block Diagram.

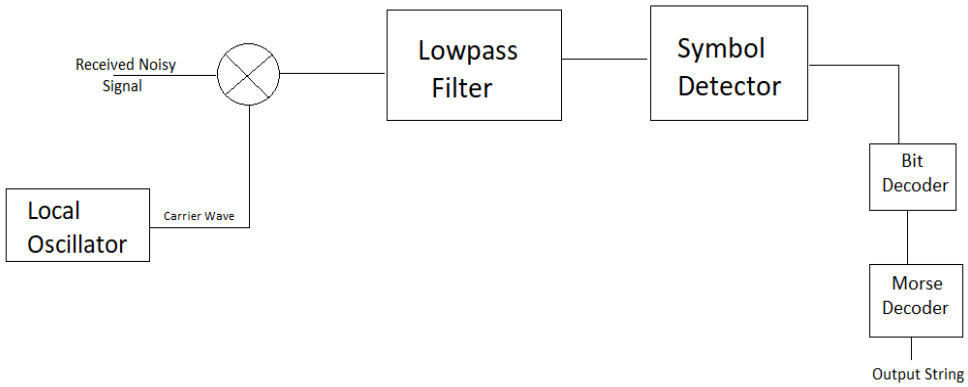


Channel Adds noise to the received passband signal.
Noise is added to the passband signal as:

recvd _noisy = awgn(passband_signal,snrdb,'measured')

3) Demodulator :

Block Diagram,



- First the Received noisy signal is multiplied with the carrier wave.
- After this step the output of the above operation is passed through the Lowpass filter. This Lowpass filter is simulated by *lowpass.m* .
- The Symbol Detector first detects the Symbols and then converts these symbols into bits by removing the repetitions. This Symbol detector is simulated by *signal2bits.m* .
- The received are then converted to morse code by the Bit Decoder. This Bit Decoder is simulated by *bit2morse.m* .
- Finally the Morse Code is converted to a string by the Morse Decoder. This Morse Decoder is Simulated by *morse2string.m* .

The Journey Of our Message

Hello World

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. . . .- . . .- . . --- .-- --- .-. .-. . . -. .

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0001010101000100010111010100010111010100011101110111000000010111011100011101110111000101110100010111010100011101010 00

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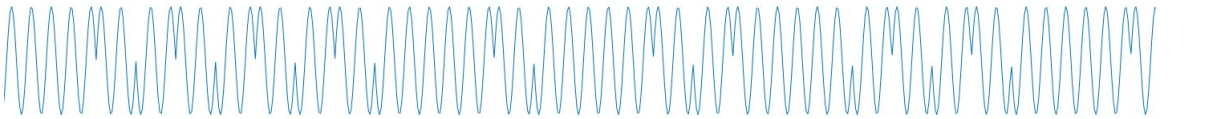

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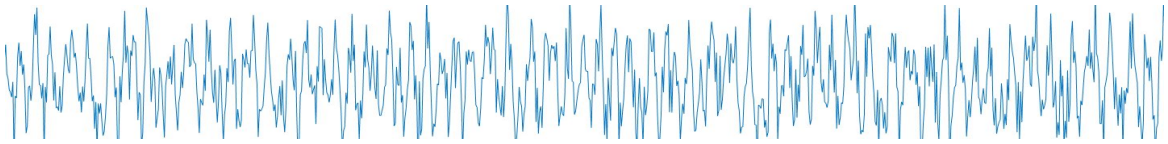

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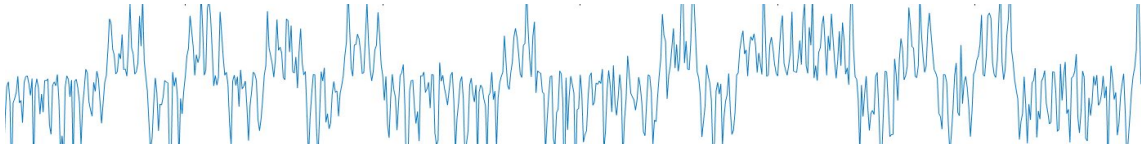

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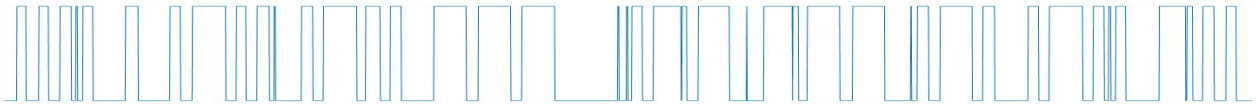

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0001010101000100010111010100010111010100011101110111000000010111011100011101110111000101110100010111010100011101010 00

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. . . .- . . .- . . --- .-- --- .-. .-. . . -. .

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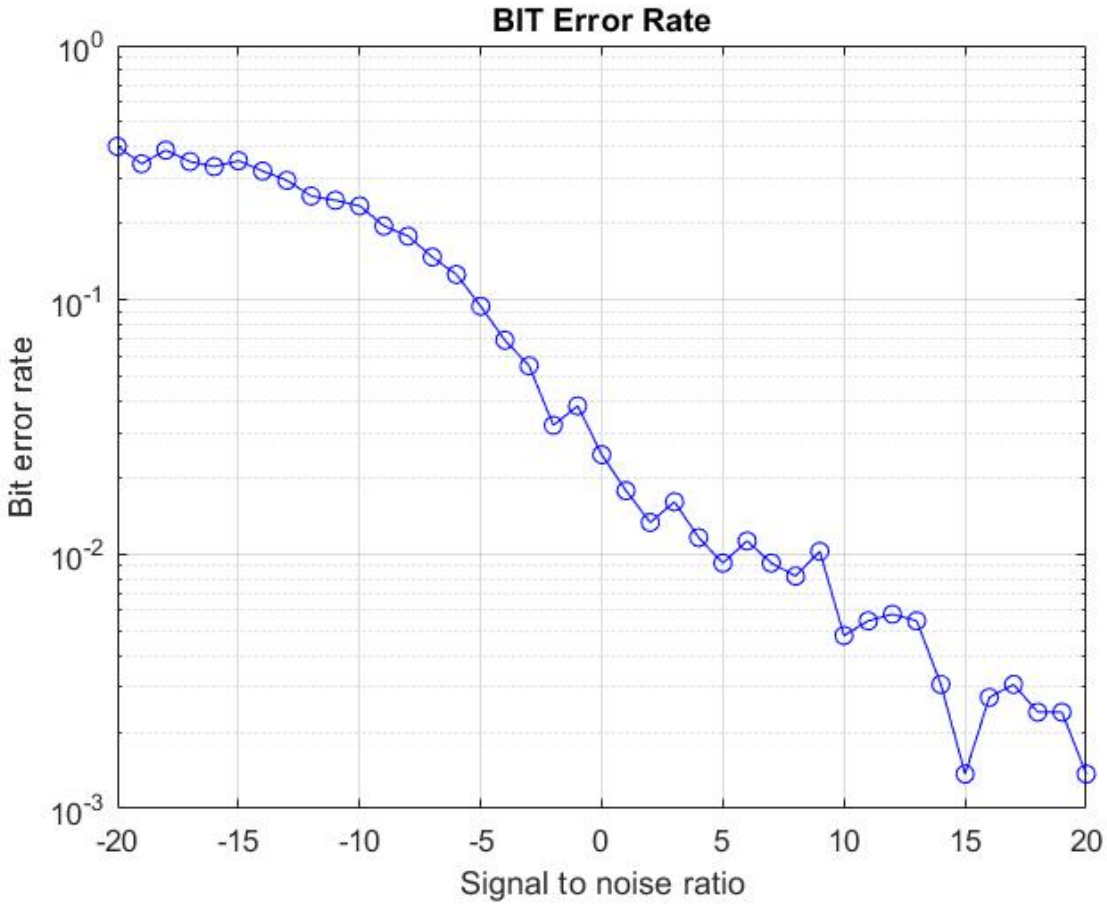
HELLO WORLD

Error Rates :

1) **Bit Error Rate :**

Bit error rate is computed by the script *bitErrRate.m* ,
For Computing BER a message "*Hello World*" is sent through the *commSystem.m* and the received bits are checked the process is repeated for SNR = -20 to 20 .

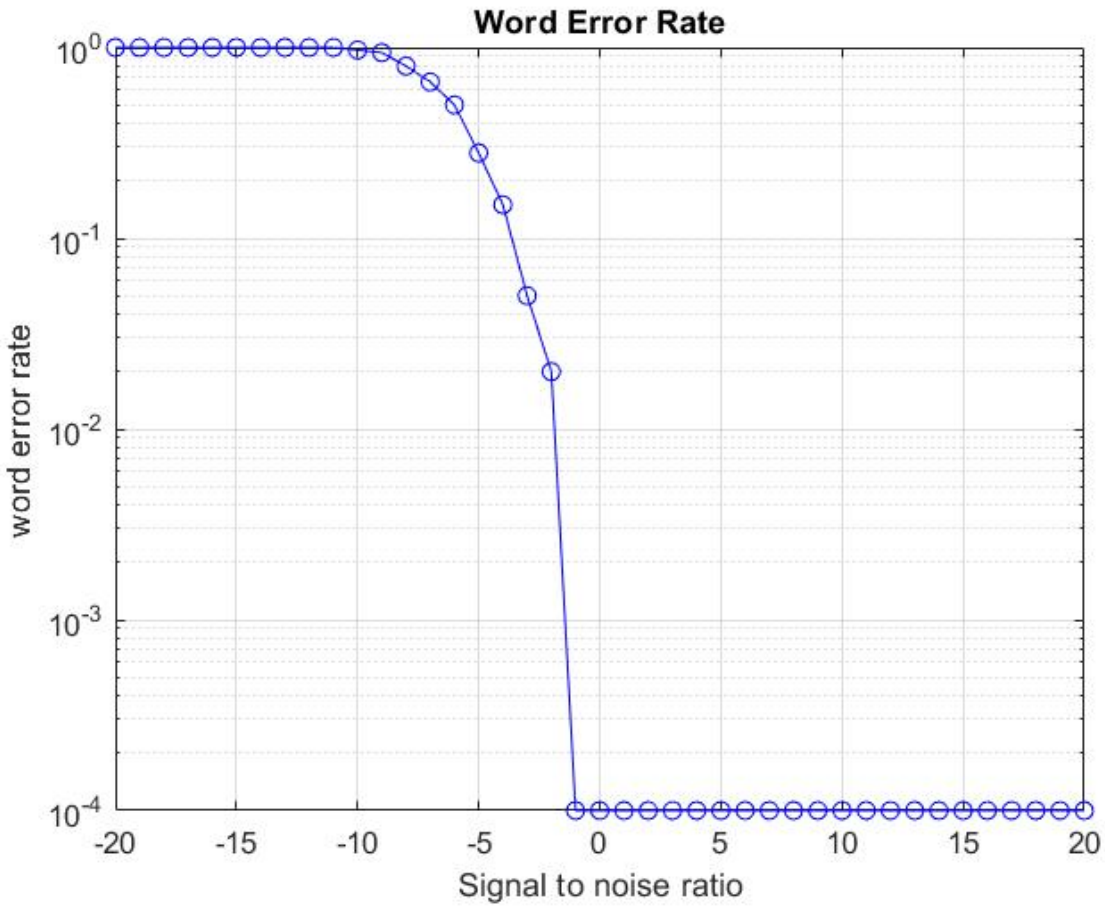
Hence, BER for a certain SNR = $\frac{(no.\ of\ wrong\ bits\ received)}{(total\ no.\ of\ bits\ sent)}$



2) <u>Word Error Rate</u> :

Word error rate is computed by the script *wordErrRate.m* ,
For computing WER the word "*HELLO*" is sent through the *commSystem.m* 100 times for a certain value of SNR and then the received message is checked the process is repeated for SNR = -20 to 20.

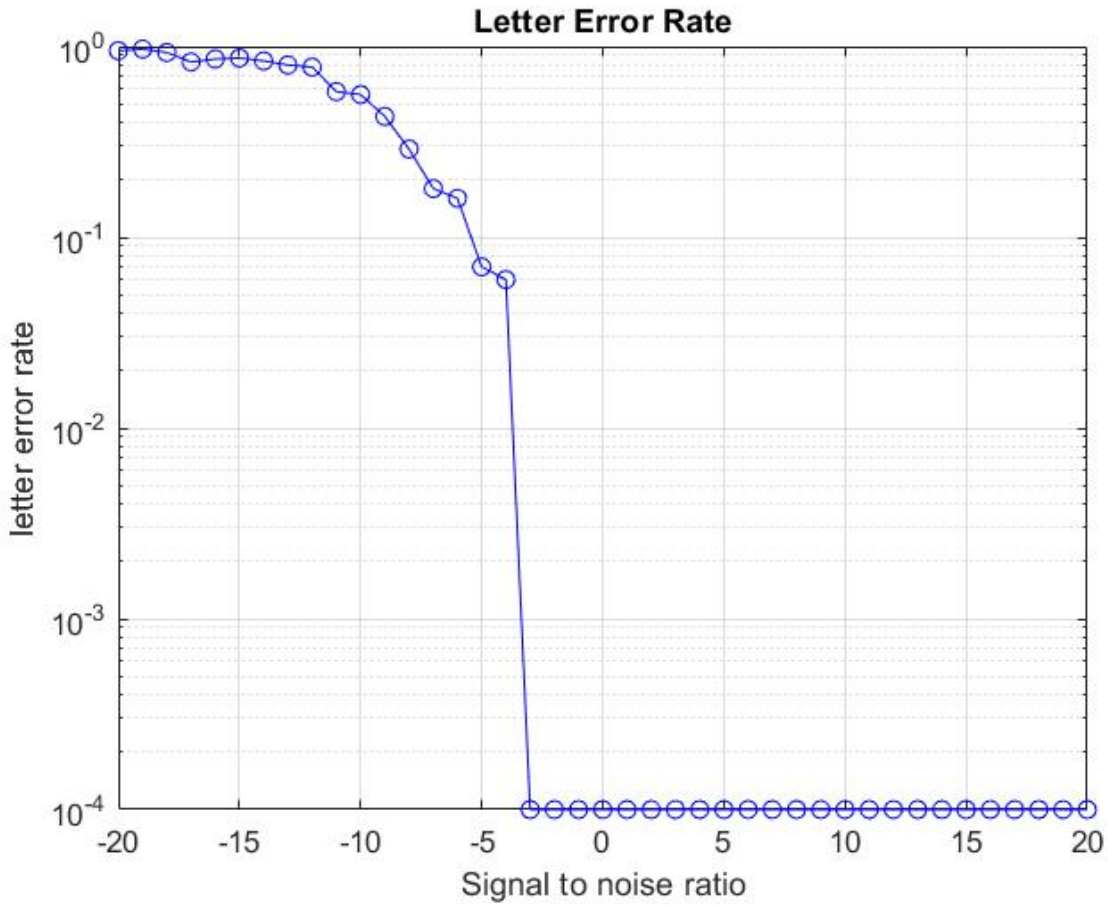
Hence, WER for a certain SNR = $\frac{(no.\ of\ wrong\ words\ received)}{100}$



3) **Letter Error Rate** :

letter error rate is computed by the script *letterErrRate.m* ,
For computing LER the various capital letters are sent through the *commSystem.m* 100 times for a certain value of SNR and then the received message is checked the process is repeated for SNR = -20 to 20.

Hence, LER for a certain SNR = $\frac{(no.\ of\ wrong\ letters\ received)}{100}$



Note* As we have to plot on a DB scale I have set a condition such that if error is 0 it is stored as 0.01 as 0 cant be plotted on the log scale.
(*The process changing 0 to 0.01 is done for visualization purpose only*)

Guide For Running the code :

As there are alot of functions the code is separated into Various scripts.
To See a demo of the project Run *Main.m* file in Matlab, ensure all the scripts are in the same directory and are added to the path.

Once You run the *Main.m* script the console will lead you further.
Please follow the instructions given on the console properly to get the best results.

***Note** please be patient while LER and WER are being calculated it may take a few seconds (10 - 15 sec each).

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