International Journal of Trend in Research and Development, Volume 3(6), ISSN: 2394-9333
www.ijtrd.com

Forward Error Correction Encoding Scheme

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Abstract-- This paper mainly contributing focus on various scheme for forward error correcting encoder .The FEC coding scheme is used to secure data and information sent over the . Generally two main categories of channel coding as convolution codes and block codes. Convolution encoders are widely used to improve the performance of various wireless applications. The various schemes and encoders are revived and explained. The Hamming Codes , BCH Codes , RS Codes and LDPC Codes has been introduce with FEC technique.

I. INTRODUCTION

In the world of digital communication system, error detection and error correction is an important for reliable communication. Error detection techniques are much simpler than the forward error correction (FEC). The main purpose of forward error correction (FEC) is to improve the capability of channel by adding some carefully designed unneeded information to the data is to be transmitted throughout the channel. The process of adding this unneeded (redundant) information is known by the name channel coding. Basically Convolution coding and block coding are two main forms of channel coding. Block codes operate on comparatively large message blocks. Convolution codes operate on serial data, may be on one or on few bits at a time. Generally used block codes are known as Hamming Codes, Reed Solomon Codes, Golay Codes and BCH Codes.

During digital data transmission and storage operations, performance is commonly determined by BER which is the ratio of Number of error bits / Number of total bits. Noise in signal transmission medium disturbs the signal and causes data corruptions[13]. Relation between signal and noise is described with SNR (signal-to-noise ratio). Generally, SNR is given by signal power / noise power and is inversely proportional with BER. It means, a lesser amount of the BER results in higher the SNR and the improved communication quality [2].

II. TYPES OF FEC

Block codes and convolution codes are the main category of FEC scheme.

There are numerous ways of classifying the forward error correction codes as per different characteristics [2].

1. Linear Vs Nonlinear- Linear codes are those codes in which the sum of any two valid code words is also a valid code word. In case of nonlinear code this statement is not always true.
2. Cyclic Vs Non-Cyclic - Cyclic code word are those in which shifting of any valid code word is also a valid code word. In case of non-circular code word this statement is not always true.
3. Systematic Vs Nonsystematic- Systematic codes are those in which the actual information appears unchanged in the encoded data and redundant bits are further added for detection and correction of error. In non-systematic code the actual message does not come into view in its original form in the code rather there exist one mapping technique from the data word to code word and vice versa.
4. Block Vs convolutional -The block codes are those technique in which one block of message signal is transformed into on block of code. In this case no memory register is required. In case of convolutional code a sequence of message bits is converted into a sequence of code. Hence encoder requires memory or shift registers as present code is combination of present and past message.
5. Binary vs. Non binary -Binary codes are those in which error detection and correction is done on binary information i.e. on bits.

Hence after the error is detected, correction means only flip the bit found in error. In Non-binary code error detection and corrections are done on symbols, symbols may be binary though. Hence both the error location and magnitude is required to correct the symbol in error.

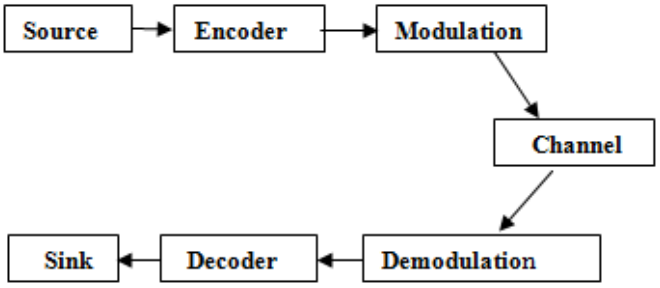

Figure 1: Digital Communication system, channel coding.

As seen in Figure 1, [12] convolutional encoding is one way of performing channel coding. Another method uses block codes. In these methods, redundant bits are used to help determine the occurrence of an error due to noise present in the channel. In the receiver, Viterbi decoding is a way of performing channel decoding. Another method is turbo codes. Turbo codes can be applied to the encoding process too. In these methods, errors can be "automatically" corrected (within specified limitations) to recover the original information [12] .

III. CONVOLUTION ENCODER

Basically Convolutional coding is a bit-level encoding system. Convolutional codes are used in such a applications that require good performance with low implementation cost. By using convolutional codes a continuous series of information bits is mapped into a continuous series of encoder output bits. Encoded bit depends on current input bits as well as on past input bits. This mapping is extremely systematic so that decoding is possible. As compared with the block codes, convolutional codes have larger coding gain [18].

Convolutional encoder map a continuous data into a continuous data of encoder output. Thus convolutional encoder is a finite state machine, which is having memory registers of past inputs and also having a finite number of diverse states. The number of output bit depends on the number of modulo 2-adders which is used with the shift registers.[12]

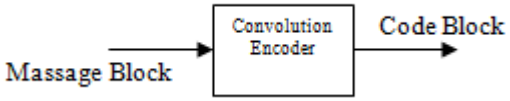

Figure 2: Convolution Encoder

Convolution codes are commonly specified by the three parameters (n, k, m) , where

n = number of output bits

k = number of input bits and,

m = number of shift registers.[18]

Usually k and n parameters ranges from 1 to 8, m ranges from 2 to 10, and the code rate varies from 1/8 to 7/8 except for deep space applications where code rates is as low as 1/100 or even longer can be employed. Convolution codes may also be specified by the parameters (n, k, L) where, L is known as the constraint length of the code and is defined as the number of bits in encoder memory that affects the production of the n output bits.[5][15][16]

To pass the information sequence to be transmitted through a linear finite shift register which generates a convolutional code. Shift register consists of k bit stages with n linear algebraic function generators. Contents of shift register are multiplied by respective term in generator matrix and then XORed together to produce respective generator Polynomials.[19]

Below figure 3, shows the comparison of FEC and Convolution Encoder. The error probability 0.42 to 0.58 limiting and signal power 0 dB to 25 dB simulated. The figure encountered the result of both FEC and Convolution scheme .the error probability of FEC is less as compared to convolution encoder.

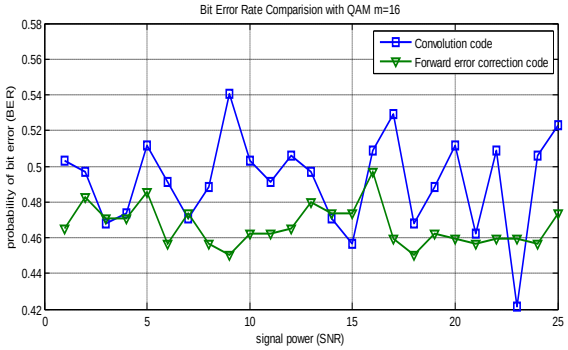

Figure 3: Error performance FEC vs Convolutional Encoder.

CONCLUSION

The FEC encoder and convolutional encoder of rate 1/2. The analytical simulation FEC vs Convotutional has been done in MATLAB ans results obtained in terms of BER vs SNR .It is to be found that the FEC is better than convolution encoder.

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