OPEN ACCESS

International
Journal
Of Modern Engineering Research (IJMER)

BER Performance for Convalutional Code with Soft & Hard Viterbi Decoding

Umesh Kumar Pandey[1], Prashant Purohit[2]
[1]MTECH Schooler, RITS, Bhopal
[2]HOD, Dept. of EC, RITS, Bhopal

Abstract: *Viterbi decoding has a fixed decoding time. It is well suited to hardware decoder. Hear we proposed Viterbi algorithm with Decoding rate 1/3. Which dynamically improve performance of the channel.*
Keywords*: Convolution code, Sova Decoder, Viterbi Decoding, soft & hard viterbi decoding, AWGN channel.*

I. Introduction

In recent years, there has been an increasing demand for efficient and reliable digital data transmission and storage systems. This demand has been accelerated by the emergence of large-scale, high-speed data networks for the exchange, processing, and storage of digital information in the military, governmental, and private spheres. The two key system parameters available to the designer are transmitted signal power and channel bandwidth. These two parameters, together with the power spectral density of receiver noise, determine the signal energy per bit-to-noise power spectral density ratio E b/ N o. This ratio uniquely determines the bit error rate for a particular modulation scheme [1]. Practical considerations usually place a limit on the value that we can assign to E b/ N o. Accordingly, in practice, one can often arrive at a modulation scheme and find that it is not possible to provide acceptable data quality (i.e., low enough error performance). For a fixed E b/ N o, the only practical a prescribed rule, thereby producing encoded data at a higher bit rate. The channel decoder in the receiver exploits the redundancy to decide which message bits were actually transmitted. The combined goal of the channel encoder and decoder is to minimize the effect of channel noise. That is, the number of errors between the channel encoder input (derived from the source) and the channel decoder output (delivered to the user) are minimized.

There are many error-correcting codes, with roots in diverse mathematical disciplines that are used. Historically, these codes have been classified into block codes and convolutional codes. The distinguishing feature for this particular classification is the presence or absence of memory in the encoders for the two coding systems

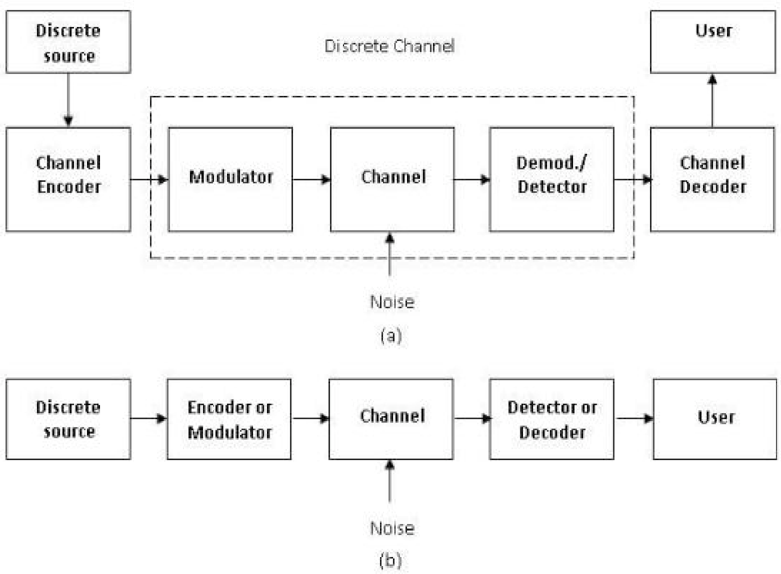

Fig. 1 Simplified models of digital communication system (a) Coding and modulation performed separately. (b) Coding and modulation combined

These Viterbi Decoding has the advantage that it has a fixed decoding time but its computational requirement grow exponentially as a function of the constraint length, so it is usually limitation in practice to constrain lengths of V=9 or less. Convolution code with 1/3 Coding Rate in BPSK and AWGN channel.

II. VITERBI ALGORITHM

Viterbi Decoing was developed by Andrew j. Viterbi in 1967 and in the late 1970's become the dominant technique for convolutional codes.The Viterbi algorithm is a dynamic programming algorith m for finding the most likely sequence of hidden states – called the Viterbi path – that results in a sequence of observed events, especially in the context of Markov information sources and hidden Markov models. The terms Viterbi path and Viterbi algorithm are also applied to related dynamic programming algorithms that discover the single most likely explanation for an observation. For example, in statistical parsing a dynamic programming algorithm can be used to discover the single most likely context-free derivation (parse) of a string, which is sometimes called the Viterbi parse.

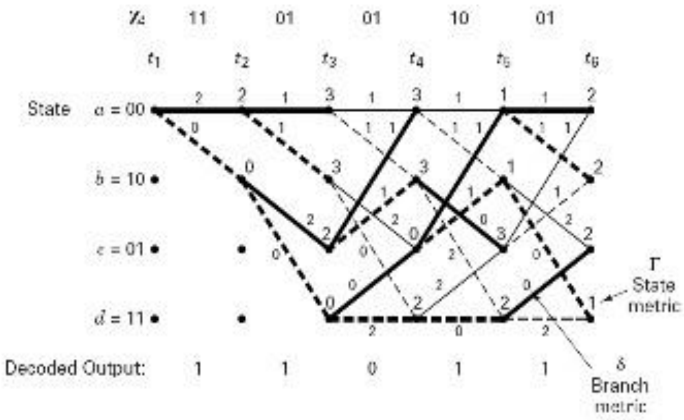

Fig. 2 : Trellis for the convolutional encoder

III. PROBLEM FORMULATION

With Viterbi Decoding the following advantage like:-

1) A highly satisfactory bit error performance
2) High speed of operation
3) Ease of implementation
4) Low cost

Most of all parameter I have tried to cover in given simulation.

Simulation Setup

The simulation setup is composed of three distinct parts, namely the encoder, the channel, and the decoder. The simulated convolutional encoder is use modulo-2 adder and shift register or constraint length (K) with code memory, of size m. In the sim- ulation, the Additive White Gaussian Noise (AWGN) channel is used and Viterbi decoder is used as convolutional decoder for hard decision as well as soft decision

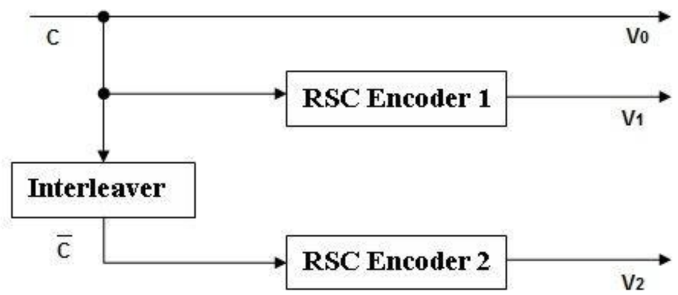

Fig. 3 : Fundamental turbo code encoder

Second, the simulation for the Turbo code encoder is composed of two identical RSC component encoders. These two component encoders are separated by a random in- terleaver. The random interleaver is a permutation of bit order in a bit stream. This permutation of bit order is stored so that the interleaved bit stream can be deinterleaved at the decoder. The output of the turbo code encoder is described by three streams, one systematic (uncoded) bit stream and two coded bit streams (parity bits), and SOVA decoder.

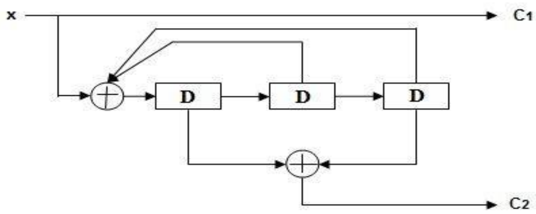

Fig. 4 RSC encoder

However, in many journal papers, the published computer simulations of above codes often use rate 1/2 ,1/3,2/3 and 3/4. This is accomplished by puncturing the coded bit streams of the above code .

Comparison Table-

E b/No (dB)	Uncoded (BER)	BPSK (BER)	BER improved over Uncoded
1.5	4.46×10^{-2}	4×10^{-2}	13.8 %
2.5	2.9×10^{-2}	6.1×10^{-2}	79.46 %
3.5	1.7×10^{-2}	3.1×10^{-2}	98.16 %

Table 1. Result of convolutional code with BPSK modulation

E b/No (dB)	Uncoded (BER)	8-PSK (BER)	BER improved over Uncoded
6	2.05×10^{-2}	1.08×10^{-2}	47.11 %
7	1.2×10^{-2}	1.6×10^{-3}	86.34 %
8	6.2×10^{-3}	1.16×10^{-4}	98.11 %

Table 2. Result for Rate- 1/3 soft decision convolutional code

IV. SIMULATON RESULT

Simulation results for a convolutional code are based on bit error rate (BER) performance over a range of E b/ N o. The BER is simply the ratio of incorrect data bits divided by the total number of data bits transmitted. The SNR is computed by di-viding the energy per received data bit Eb by the single-sided noise spectral density no of the channel. For simulation rate 1/3,2/3 and 1/2 convolutional codes and turbo codes rates using two RSC encoder and interleaver is used.

First, the simulation results are shown for convolutional code using different modulation technique (BPSK, QPSK and 8-PSK) with rate 1/2 and different rate (using one modulation technique (BPSK) in AWGN channel. The simulation is carried out on the basis of BER improvement over uncoded BER given by equation:

$$\frac{\text{BER uncoded} - \text{BER coded}}{\text{BER uncoded}} \; 100\%$$

Second, the performance of rate turbo code encoder is shown with RSC encoder and SOVA decoder

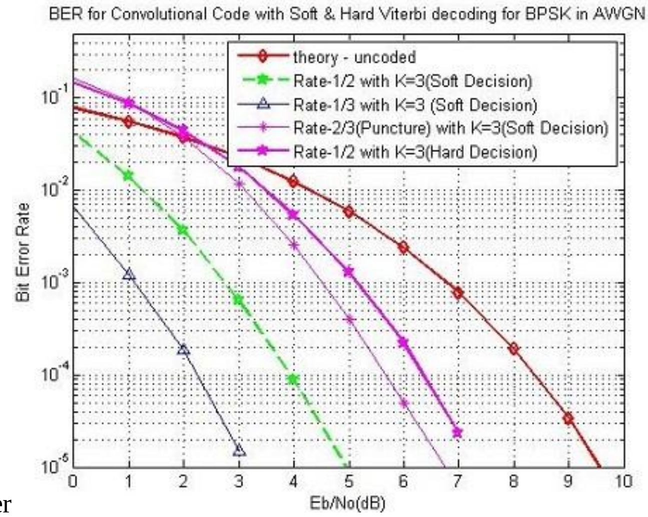

Fig. 5 Convolutional code with Different Coding Rate in BPSK and AWGN channel

V. CONCLUSION

After simulation it is showing that Decoding rate performance best with BPSK. simulations of the convolution codes has been carried out in the MATLAB. Viterbi Decoding is very powerful algorithm for AWGN channel.

REFERENCES

[1] J. Hagenauer. " Source-controlled channel decoding." IEEE Trans. Commun., vol.43, pp. 2449-2457, 1995.

[2] K. M. S. Soyjaudah and M. T. Russool. "Comparative study of turbo codes in awgn channel using map and sova decoding". Department of Electrical and Electronic Engineering, University of Mauritius.2009

[3] S. Lin J. Chen, M. P. Fossorier and C. Xu. "Bi-directional sova decoding for turbocodes".IEEE Commun. Lett., vol. 4, no. 12, pp. 405-408, 2000.

[4] Lutz Papke, Patrick Robertson, "Improved Decoding with the SOVA in a Parallel Concatenated (Turbo-code) Scheme". France Telecom, CNET, 38-40 Ave. du General Le Clerc, F-92131 Issy-Les-Moulineaux, France Bhaskaracharya Inst for Space App/Geo-Informatics,2010

[5] M. K. Gupta, Vishwas Sharma, "To Improve Bit Error Rate Of Turbo Coded Ofdm Transmisalgorithm with soft-decision outputs and its applications. in Proc., IEEE Globecom Conj, pp. 1680-1686, 1989.

[7] Claude Berrou. " A low complexity soft-output viterbi decoder architecture." IEEE Trans. Commun., pp. 737-745, 1996.