BER Performance in Concatenated algorithm for Convoluted RS codes with AWGN channel for MIMO system

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Abstract— **Multiple-input multiple-output (MIMO) is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology and also promising technology for next generation wireless systems to enhance capacity and robustness of the link. The different Forward error correction methods have been implemented in current communication system to improve the Bit error rate (BER) in accordance with respective Signal to Noise ratio (SNR). In this paper we propose a concatenated algorithm for two different error correcting codes with Additive Wight Gaussian channel (AWGN) for MIMO system. In these types of codes redundant information is added at the end of message to detect and correct error. The Interleaved R-S Codes are used as outer code and inner codes are represented by convolution codes with modified constraint length and the iterative decoding algorithm is proposed. The performance comparison is made on the basis of bit error rate (BER) and symbol error rate (SER) and Signal to Noise Ratio (SNR).**

KeyWords: Inter-leaver, RS codes, mimo, RSC Encoder, AWGN, BER, Concatenated Codes,RSCE

1 INTRODUCTION

In coding theory, concatenated codes form a class of error-correcting codes that are derived by combining an inner code and an outer code. They were conceived in 1966 by Dave Forney as a solution to the problem of finding a code that has both exponentially decreasing error probability with increasing block length and polynomial-time decoding complexity. Concatenated codes became widely used in space communications in the 1970s.

Further the energy efficiency is the most considerable feature in any communication system and the approach to gain minimum BER has always been discussed and researched in all aspects.

2 CONVOLUTED RS CODES

The convoluted RS code algorithm proposed here uses the two different coding mechanisms.

1. A shortened Reed Solomon outer code with 188 data bytes and 204 coded bytes with t=8 error correcting probability.
2. A convolution inter-leaver is used with depth of 12
3. A convolution inner code is used with constraint length t=7.

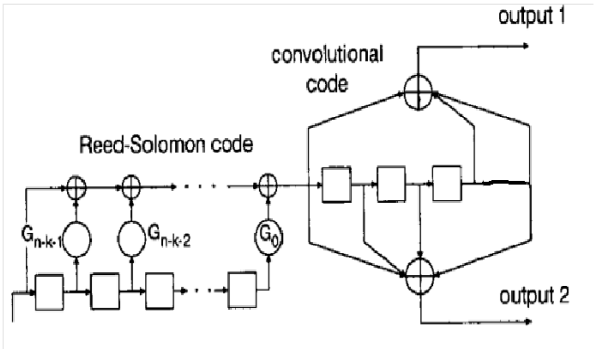

Fig.1 Encoding method for Concatenated RS code.

The proposed method in fig.1 shows the an (N,K) RS encoder where $N=2^m-1$ and (n,k) convolution encoder are considered as a single encoder with constraint length K=3.The different states of both encoder are shifted accordingly with different inputs applied.

When any input is given to this mechanism the related inputs are transformed to m bits after a one time transition and then they are fed to convolution encoder with constraint length k=3 and the output of convolution encoder's output results in m-shift of all inputs.

RECURSIVE SYSTEMATIC CONVOLUTION ENCODING(RSCE)

A conventional convolution encoder is an FIR filter with operations over GF(2).RSC encoder can be constructed from a standard convolution encoder by feeding back one of its outputs. An RSC encoder has an infinite impulse response. An arbitrary input will cause a "good" (high weight) output with high probability.

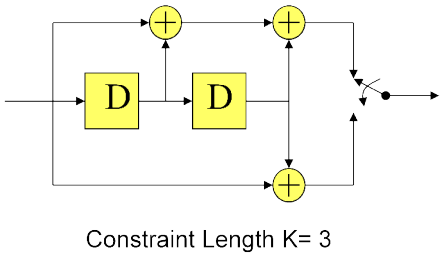

Fig.2 An RSC encoder with constraint length K=3

3 PROPOSED METHODOLOGY

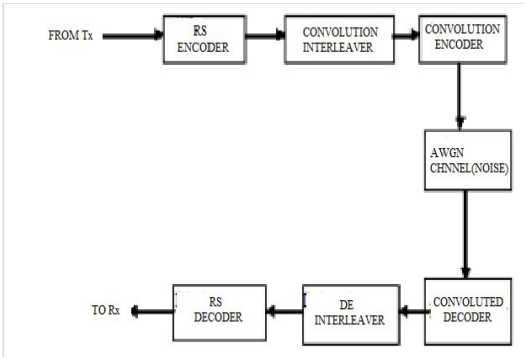

Fig.3 Block diagram of the system

The method proposed in the above diagram shows the flow of the process with concatenated algorithm. The shortened RS outer codes with 188 data byte and 204 coded byte are used along with t=8 error correcting capability. The convolution encoder used here contains the depth=12 and the convolution inner code used here represents constraint length k=7 and the rate = 1/2,2/3,3/4,5/6 & 7/8.

The decoding algorithm for proposed method can be soft output iterative algorithm[1] with different input parameters.
The SISO scheme used for the decoding operation contains the RSC decoder with different input and different output.

Fig.4 Soft Input Soft Output Decoding

In the SISO decoding we assume the source output sequence by $O=\{O_1,O_2,.....On\}$ where $O_k \in \{0,1\}$.
The SISO decoding algorithm can be defined as follows

Input $Z = \{z_1,z_2,....z_n\}$and Output $O=\{O_1,O_2,.....On\}$.
This algorithm decodes the concatenated RSC codes with effective output parameter as compared to other decoding algorithm in terms of different stage performance in error correction capabilities.

4 RESULTS

The simulation result for different BER performance is illustrated in the figure below.

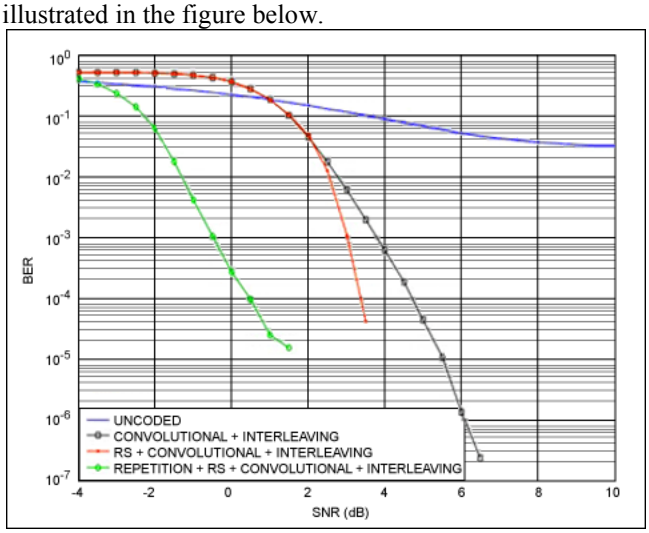

Fig.5 BER comparisons of different coding scheme

As shown in the fig it is very clear that the Bit Error Rate for convoluted RS algorithm with interleaving is least as compared to single coding and with convolution interleaving with proposed algorithm. The repetition of the same scheme further reduces the BER with increase in SNR ratio.
The table below shows the different parameter consideration for proposed scheme.

TABLE 1

PARAMETERS	VALUE(S)
Modulations	QPSK,8-PSK,16-QAM
FFT(size)	256
Over Sampling Factor	2
ECC	Convolution R =1/2,Reed Solomon(255,239,8
No. Of Iteration	4x-5x
Clipping Ratio	CR=2
Channel Noise	AWGN, Rayleigh

5 CONCLUSIONS

The proposed algorithm combines the two different coding and decoding algorithm for improving the error rate and also it represents the reduced bandwidth consumption with concatenation of codes along with additive white Gaussian noise channel suitable for Multiple input Multiple Output systems where the co-channel interference plays a vital role for producing error in adjacent channel which degrades the performance of the system at higher bandwidth. The system also represents the soft decoding algorithm for improving the error rate.

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