ERROR DETECTION AND CORRECTION IN FIR FILTERS BY USING RAPTOR CODE

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***Abstract*—*Now a day's all the communication systems are using filters. Some of the case life time of those systems is biting due the error present in the filters. Because the original information is not sent in receiver sides, so the fault tolerant is need for those system. The fault tolerant is achieved by using error correction code (ECC). The filter protection is depends on the fault tolerance. In this paper using raptor code for error detection and correction. The code can detect and correct error and also reduce the density of the sending message. Increase the process speed and low power can be required for process. Implementation cost also low, it gives more protection for the filters. Raptor code is achieved by concatenation of linear code (LT) and pre-code. LT code recovers a large proportion of input symbols. Pre-code recovers the fraction unrecovered by LT code. Raptor code can also use over a noisy channel.*

Keywords*— *Error correction code (ECC), filter, Binary erasure channel (BEC), LT code, pre-code

1. INTRODUCTION

The communication systems are used digital transmission. It means the data can be sent in the form of digital for the purpose of security. The digital transmission can use digital filters. In some case performance of the filter can be poor due the error. Because of the error the original information is changed. So the original information is not get in receiver side. Filters are often used in electronic system to emphasize signals in certain frequency range and reject signal in other frequency range. A filter is an electrical network that alter the amplitude and phase character of the signals with respect to frequency.

Ideally the filter will not add new frequency to the input signal. Nor will it change the component frequencies of the signal. But it will change the relative amplitude of the various frequency components and their phase relationship. Today filter are widely used is number of application which based on automotive, medical and space where reliability of component in digital electronic circuit is critical. Filter of some sort essential in the operation of most electronic circuit. There are different bases of classifying filter and these overlap in many different ways,

there is no simple hierarchical classification. As the behavioral properties of signal changes the techniques of filtering it will be differ. Being specific with filter, the digital filter have vast application in digital signal processing. Filtering is also a class of digital processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal. It is therefore in the interest of anyone involved in electronic circuit design to have the ability to develop filter circuit capable of meeting a given set of specifications.

In signal processing, a digital filter is a device or process that removes some unwanted component or feature from a signal. Digital filters are used for two general purposes, separation of signals that have been combined and restoration of signals that have been distorted in some way. Most often, this mean removing some frequency and no other in order to suppress interfering signals and reduce the background noise. Digital filter are very important part of DSP. In fact, the extraordinary performance is one of key reason that DSP has become so popular. As the application of digital circuit in signal processing reached to its peak, possibilities of fault and its detection and correction with in digital circuitry may also need to be advanced. However, the filter do not exclusively act in the frequency domain, especially in the field of signal processing many other target for filters exist. Correction can be removed for certain frequency component and not for other without having to act in the frequency domain. It is common in DSP to say that a filter's input and output signals are in the time domain. This is because signals are usually created by sampling at regular interval of time. The original data is encoded using some erasure correction code.

If during the transmission some part of data is lost, then it is possible to recover the lost data using this erasure correction algorithm. For the application it is crucial that the code used are capable of correcting as many erasures as possible, and it is also crucial that the encoding and decoding algorithm for these codes are very fast. The idea of raptor code to relax this condition and require that only the fraction of input symbol be recoverable.

2. CONCEPT OF FAULT TOLERANT

A number of techniques can be used to protect a circuit from the error. Those range from modifications in the manufacturing process of the circuit to reduce the number of error to add the redundancy at the logic or system level to ensure that error do not affect the system functionality. Digital filter are one of the most commonly used signal processing circuit and several techniques have been proposed to protect them from errors. There are number of methods used to identify faults and action necessary to correct the faults within circuit digital filter are widely used in signal processing and communication system. There are different fault tolerance approaches to conventional computational circuit and the DSP circuits. In some case, the reliability of those system is critical, and fault tolerant implementation are needed. Over the years, many techniques they exploit the filters structure and properties to achieve fault tolerance have been proposed. In all the techniques mentioned so far, the protection of the single filter is considered.

3. LITERATURE SURVEY

The design of fault tolerance based system depend on error correction code (ECC) using VHDL is designed and implementation, tested [1]. It proposes that with the help of ECC. Therefore error correction code there will be more protected parallel filters circuit has been possible. The filter they have used for error detection and correction are mainly finite impulse response (FIR) filters. They have been used hamming code for fault correction in which they takes a block of k bits and produce a block of n bits by adding n-k parity check bits. The parity check bits are XOR combination of k data bits. By properly designing those combination it is possible to detect and correct in scheme they have been used redundant module in which the data and parity check bit are stored and can be recovered later even if there is an error in one of the bits this is done by re-computing the parity check bit and comparing the result with value stored. In this way using hamming code error can be detected and corrected within the circuit.

The design of Triple modular redundancy (TMR) and hamming code have been used to protect different circuit against single event upsets (SEUs) in [2]. In this paper, use of the novel hamming approach on FIR filters is studied and implemented in order to provide low complexity, reduce delay and area efficient protection techniques for higher bits data. A novel hamming code is proposed in this paper, to increase the efficiency of higher data bits. In this paper, they have proposed techniques used to demonstrate, how the lot of overhead due to interspersing the redundancy bits, their subsequent removal, total area of FIR filter for higher bits are reduced. These are based on the novel hamming code implementation in the FIR filter instead of conventional hamming code used to protect FIR filter. In this scheme hamming code used for transmission of 7-bits data item.

The design of FIR filter with self-checking capabilities based on the residue checking is analyzed [3]. Usually the set of residues used to check the consistency of the result of FIR filter based of theoretic consideration about the dynamic range available with a chosen set of residues, the arithmetic characteristic of error caused by a fault and on the characteristic of filter implementation. This analysis is often difficult to perform and to obtain acceptable fault coverage the set of chosen residues is overestimated. Obtained result and therefore requires that instead, in this paper they have showed how using an exhaustive fault injection campaigns allows to efficiently select the best set of residues. Experimental results coming from fault modules corresponding to different residues has been possible to reduce the number of detection module, while paying a small reduction of the percentage of SEUs that can be detected. Binary logic dominates the hardware implementation of DSP systems.

The design they have proposed an architecture for implementation of fault tolerant computation within the high throughput mutilate equalizer for an asymmetrical wireless LAN [4]. The area overhead is minimized by exploiting the algebraic structure of the Modulus Replication Residue Number System (MRRNS). They had demonstrated that for our system the area cost to correct a fault in single computation channel is 82.7%. Fault tolerance within MRRNS architecture is implemented through the addition of redundant channels. This paper presented a detailed analysis of the cost of the implementing single fault correction capability in a FIR filter using the MRRNS. The fault tolerant architecture makes the use of the algebraic properties of the MRRNS, and has been shown to provide significant area savings when compared with general techniques. This architecture also requires few additional components to be designed, as identical redundant channels are used, and the polynomial mapping stages are simply expanded from the original components.

4. PROPOSED SYSTEM

LT code is new class code introduced by Luby for the purpose of fault tolerant distribution of the data over the network. In this paper, we introduced raptor code is extension of LT code with linear time encoding and decoding. Raptor code parameters are (K, C, Ω(x)).Here the K is input symbols of raptor code. The code C are called pre-code of raptor code Ω(x) is degree distribution of raptor code.

We will exhibit a class of universal Raptor code: for a given integer and any real >0.Raptor code in this produce the potentially infinite stream of symbols such that any subset of symbols of size K(1+) is sufficient to recover the original K symbols with high probability.

Each output symbol is generated using O (log (1/)) operation. The original symbols are recovered by the collected ones with O (K log (1/) operations.

Raptor code is achieved by concatenation of LT code and precode.LT code is used to recover the large input symbols. The pre-code are used to recover the remaining symbols. For example the LT code recovered 90% of input symbols and remaining 10% of input symbols is recovered by the pre-code.

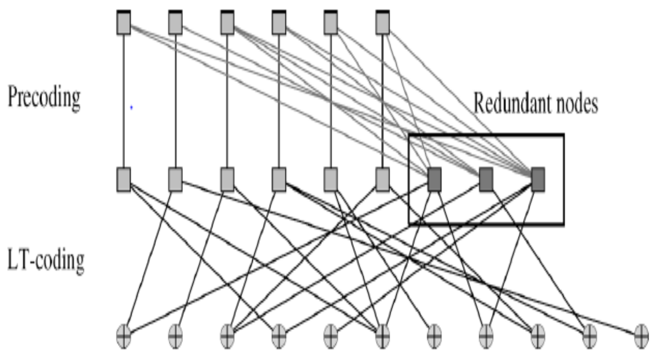

Fig. 1. Raptor codes: the input symbols are appended by redundant symbols (black squares) in the case of a systematic pre-code. An appropriate LT-code is used
to generate output symbols from the pre-coded input symbols.

The result of the previous section imply that LT codes cannot be encoded with constant cost if the numbers of collected output symbols so close to the number of input symbols. In this section, we will present a different class of Fountain codes. One of the many advantage of the new construction is that it allows for encoding and decoding with constant cost, as we will see below.

The reason behind the lower bound of **log (k**) for the cost of LT codes is the information theoretic lower bound of proposition. The decoding graph need to have an order to make sure that all the input nodes are covered with high probability.

5. FOUNTAIN CODE AND LT CODE

The theoretical idea of fountain codes was introduced in [5] and the first practical realization of Fountain codes were invented by Luby. They represent a new class of linear error correcting codes. Each output of LT code is generated by randomly choosing a degree d from some suitable degree distribution, choosing distinct input symbols uniformly at random, and taking their sum.

$$\propto \geq In(K) \quad \frac{u}{1+\frac{uIn(K)}{n}}$$

$$\geq In(K) \quad \frac{u}{1+uIn(K)/K}$$

$$\geq In(K) \quad \frac{u}{1+uIn(3)/3}$$

= log (K) u/log (2) (1+uIn (3)/3
= Clog (K).

If the output symbols degrees are chosen according to the Robust Scion proposed ,K input symbols can be recovered from any K+O(klog2(k/δ)) output symbols with probability 1-δ.The average encoding and decoding cost is O(log(k/δ)).

6. LIMITATION OF LT CODE

The following proposition shows that the decoding graph of a reliable decoder for an LT code has at least O (K log (K)) edges. It follows that if the number m of output symbols needed for decoding is close to K, then each output symbols the sum of O (log (K)) input symbols on average. The per symbol encoding cost is then O (log (K)).

PRE-CODE

At the other end of the spectrum are pre-code only of raptor code. These codes have a sophisticated pre-code but a trivial output distribution Ω(x) =x, which sets the value of every output symbols to that of a randomly and uniformly chosen input symbols. This approach in effect builds a fountain code form any block code.

The decoding algorithm collects a predetermined number m of output symbols, which determines the values of some number l of intermediate symbols. The decoding algorithm for the pre-code is then applied to these recovered intermediate values to obtain the value of input symbols. The performance of a pre-code only raptor code depends on the performance of its pre-code.

7. RAPTOR CODE

The key idea of Raptor coding is to relax the condition that all input symbols need to be recovered. If an LT code needs to recover only a constant fraction of its input symbols, then its decoding graph need only have O (K) edges, allowing for linear time encoding. We can still recover all the input symbols by concatenating pre-code with LT codes. n intermediate symbols are obtained by encoding k inputs symbols with an (n, k) erasure correcting block code capable of recovering all the input symbols from the fixed fraction of intermediate symbols.

The n intermediate symbol are then encoded with an LT code that can recover from its output symbols the required fraction of intermediate symbols. A Raptor code is specified by parameters(K,C,Ω(X)),where C is the (n,k) ensure correcting block code called pre-code, and Ω(X) is generator polynomial of the degree distribution of LT code, i.e. Ω(X)= , where the Ωt is the probability that degree of an output node is i.

The performance parameters overhead and decoding cost as defined in section apply directly to Raptor codes. However, the definition of the encoding cost of the Raptor code differs slightly. It is the sum of the encoding cost of the pre-code divided by k, and the encoding cost of the LT code. Raptor codes also require storages for intermediate symbols, so space consumption is another important performance parameter.

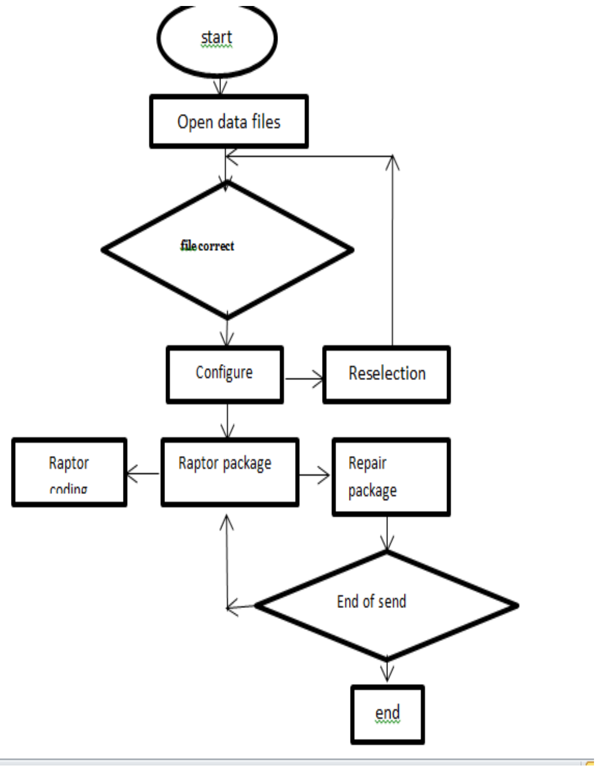

Fig.2. Flow chart for raptor coding

8. SIMULATION OUTPUT

The FIR filter are designed in VHDL .Simulation is done using Xilinx ISE design suite 14.1.This simulation result for FIR filter by using raptor for error detection correction. This output give the error free filters. It is designed for 8 bits of FIR filter.

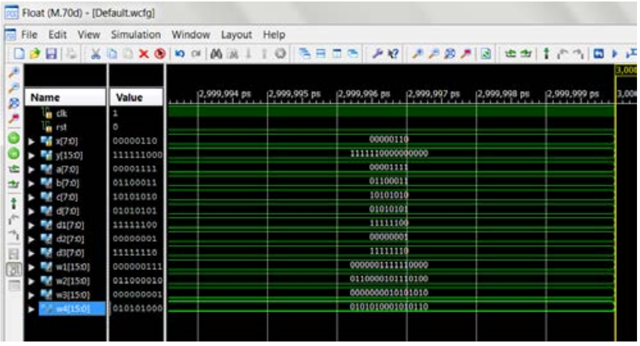

Fig:3 simulation result for FIR filter

EXISITING SYSTEM TABLE- I

	Unprotected	TMR	Method in[7]	Existing
Slices	2944	9020	7740	6409
Flip-Flops	1224	3984	3980	2941
LUTs	5692	17256	13640	12032

PROPOSED SYSTEM TABLE-II

	Unprotected	TMR	Method in [7]	Proposed
Slices	3096	8752	6321	5013
Flip-Flops	1122	2988	2543	1987
LUTs	6259	19344	17550	15064

9. CONCLUSION

In this proposed system a new scheme is introduced to protect the parallel filter of FIR filters. These filters are mainly used in signal processing and communication. Because of the error the filters are exploit.so the fault tolerant is needed for the filter. The fault tolerant can feed the protection for the filters. So the fault tolerant is achieved by using error correction codes.

Proposed system is using raptor code for error detection and also used for correction. This code provide the error free filters. The fault tolerant is achieved by this raptor code. It proved the high speed and low power consumption and also correct the multiples of error in the filters

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