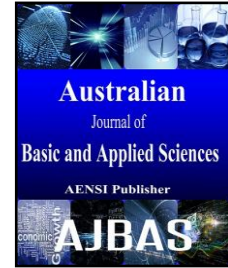




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### Design of Reed-Solomon Code Cross Interrupt for LDPC Error Attenuate Decoder on Frequency Division Multiplexing Systems

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#### ABSTRACT

Data line systems establishes wireless channel which ensures high data rate communication. The data lines act as destructive and noisy channel when they are engaged as a communication medium on Low-Density Parity-Check coded (LDPC) Orthogonal Frequency-Division Multiplexing (OFDM). The encoding scheme easily encodes the system, but, the LDPC iterative decoding is not effective on reducing the error probability rate on wireless communication channel. At the same time, the LDPC decoding or lower bit error probability produces the result with higher complexity rate. To overcome the complexity on data line wireless communication system, Reed-Solomon Code Cross Interrupt based Error Attenuate Decoder (RCCI-EAD) framework is proposed in this paper. Initially, RCCI-EAD framework performs the encoding operation on OFDM using Reed-Solomon, which is non-binary cyclic error-correcting code. The receiving end uses the Cross Interrupt based Error Attenuate Decoder for input error correction on the encoded system. The cross interrupted code error using RCCI-EAD framework is rectified on wireless communication channel within the interleaving scheme. Experiment is conducted on factors such as delay line code, maximum interpolation length time on OFDM channel, and error correcting efficiency rate.

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#### INTRODUCTION

With increasing demand for visualizing maximum interpolation length time on OFDM channel such as digital audio broadcasting, digital video broadcasting, it is very important to lower bit error probability efficiently. Due to pilot bits and bit error ratio limitations, there has been a great deal of research effort into the estimation of iterative channel using LDPC decoding (Mi-Kyung, 2008) and iterative multicarrier detector using LPDC decoding (Shu-Ming Tseng, 2012). On the other hand, iterative decode does not reduce the error probability rate on wireless communication channel.

The pioneering work of OFDM (Kadir, 2014) using space time blocks with the reduction of SNR was introduced. In (Xia Hong, 2014), non linear equalization method Channel Impulse Response (CIR) coefficients were obtained by applying standard least square algorithm. Drawback of this algorithm is that they are not linear with respect to the channel size.

In (Jiankang Zhang, 2014; Kadir, 2013), obtaining optimal solutions for OFD/SDMA and OFD/SC-FDMA represented by Differential

Evolution Algorithms (DEA) and Localized Frequency Division Multiplexing Algorithms (LFDMA) is described. However, spatial correlation is not performed with respect to different transmission antennae. In (Zhen Gao, 2015), a channel estimation scheme based on low complexity is proposed for Time Domain Synchronous-Orthogonal Frequency Division Multiplexing (TDS-OFDM) with the motive of reducing the computational complexity among fading channels.

OFDM is also used to reduce bit error rate. Quadrature Amplitude Modulation (QAM) was employed with Differential Evolution (DE) algorithm and their performance with respect to complexity was addressed. Time Domain Interpolation (TDI) is deployed to measure the mean square error using Discrete Fourier Transform (DFT). In (Aykut Kalaycioglu, 2010), frequency and TDI, Gallager's approach was applied to measure the complexity and delay in addition to error rate using channel estimation algorithm. In (Gabriel Falcao, 2012), a tanner graph model for minimizing the power consumption in Digital Video Broadcasting Satellite (DVBS) is proposed using Belief Propagation (BP) algorithm.

In this paper we address implementation details of the two aforementioned methods namely the Reed-Solomon encoding and Cross Interrupt based Error Free Decoder, and layout a guideline for implementing the complexity on data line wireless communication system on frequency division multiplexing systems.

### Design of Reed-Solomon Code Cross Interrupt for LDPC Error Attenuate Decoder:

OFDM system with LDPC coding is used to support the system to work with the input data bit stream. The stream is encoded by employing the Reed-Solomon encoding. The encoder generates the parity check and also at the receiver end identifies the error rate on both the ends. OFDM encoder is characterized by the data rate with polynomial  $p(x)$  over a finite field. The data line channel is considered as a series of discrete stationary state that need to be identified for effective line channel where varying frequency based transmission is carried out. This type of transmission leads to interruption with the numerous noise sources at the decoding size of OFDM systems. In order to reduce the interruption, Low-Density Parity-Check (LDPC) coding on wireless channel based data transfer function is applied in RCCI-EAD and is formularized as,

$$P(f) = \sum_{r=1}^{r-1} g e^{-(\alpha_0 + \alpha_1 f)} e^{\frac{j2\pi fl}{v}} \quad (1)$$

The power line 'P' based transfer function 'f' uses the aggregation form to transfer the whole data line to the other end (i.e., receiver end) where 'g' measures the compound tap factor for each data line path with 'l' denoting the path length and  $\alpha_0, \alpha_1$

representing the attenuation factor with 'v' representing the velocity of propagation. The decoder side also identifies the interruption point to identify the occurrence of noise. The architecture diagram of Reed-Solomon Code Cross Interrupt based Error Attenuate Decoder (RCCI-EAD) framework is shown in Figure 1.

As shown in Figure 1, the data line with Reed Solomon Encoding is applied to work effectively and remove the non-binary cyclic error. The correcting code with polynomial field improves the efficiency with high complexity rate. Reed Solomon Encoder with error probability involves a higher bounded union operation. The union operation is expressed as,  $UB(E_p) = Distance \cup R_c$  (2)

The higher bound 'UB' with the error probability 'E<sub>p</sub>' is measured with the union operation. To measure the higher bound, the distance 'Distance' and the rate at which the data is transferred 'R<sub>c</sub>' are aggregated together to reduce the error probability rate. The operation is carried out to correct the code of error probability through union operation using Reed Solomon encoding to improve the efficiency rate. The Low-Density Parity-Check (LDPC) encoder with the Reed Solomon corrects the code with the polynomial field of (x) on data transfer. Similarly, the new framework is introduced on the decoding side in the proposed work to perform effective error attenuate decoding process.

The framework named Cross Interrupt based Error Attenuate Decoder is introduced on the decoder side to improve the efficiency of data transfer in OFDM channel systems.

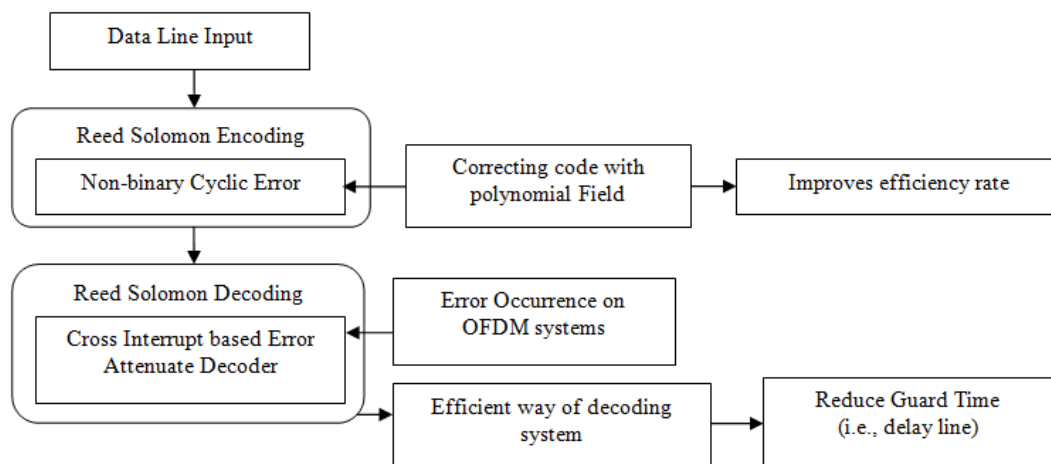


Fig. 1: Architecture diagram of RCCI-EAD framework.

#### A. Data Line Encoding System:

The OFDM system encoded with the input data sequence uses the Reed Solomon procedure. It encodes the data sequence using the phase and magnitude 'm' of subcarriers. The m-bit groupings of data are encoded as complex values with non-binary cyclic form.

The occurrence of error occurrence due to noise or any other interference is identified and it is rectified using RCCI-EAD Framework. The Reed Solomon based encoding uses the non-binary cyclic set on the polynomial field to reach higher efficiency result.

The polynomial field with 'k' data bits is

encoded over the length 'l' and it is formularized as,  

$$[p(x)] = \prod_{i=1}^n (x - \alpha^i) = (x - \alpha)(x - \alpha^2) \dots (x - \alpha^{n-1}) \quad (3)$$

In (3), ' $\alpha$ ' denotes the primitive 'N' root of unity that occurs on the 'n' bit of data. The polynomial field  $[p(x)]$  with low density parity checks code contains the 'n' bit on the field 'x'. The encoded code with the Reed Solomon form overcomes the noisy type of disturbances. The distances are reduced widely in the RCCI-EAD Framework.

### B. Cross Interrupt Based Error Attenuate Decoder:

The main objective of RCCI-EAD framework is to correct the error on the decoder side without any complexity rate. The number and all type of errors are corrected depending on the Reed-Solomon code based on Cross Interrupt removal procedure.

Cross Interrupt separates the original data and the parity bit for the easy identification of

interruption point. The cross interrupt is identified with sample that includes both even and odd number's. The error occurred on the input system are spread over the large number of frames till reached to the decoding side and is shown in Figure 2.

The cross interrupted code error in RCCI-EAD framework is rectified on wireless communication channel within the interleaving scheme. The interrupted structure is easily identified at the initial stage and delay lines at the decoding stage are also reduced.

The burst length (l) of the RCCI-EAD framework is measured for data transfer between the source and destination. The maximum interpolation length is the utmost time taken to correct the code on the decoder side in the OFDM systems. The interpolation is the approximation of the value measurement for the easy computation in LPDC encoder. The lesser the burst length is the way which improves the efficiency on the channel.

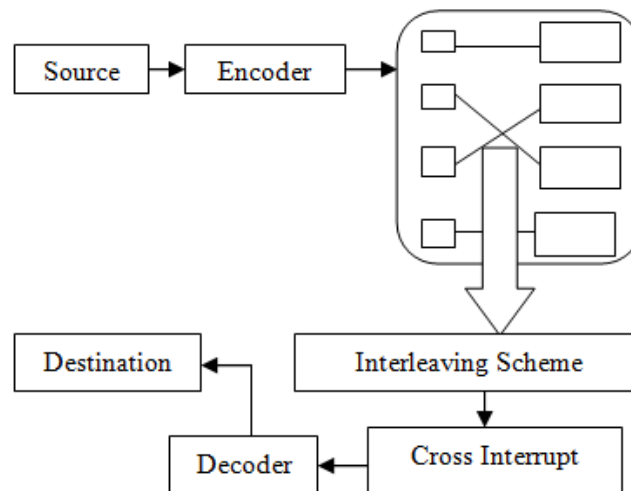


Fig. 2: Design of interleave scheme.

### Experimental Evaluation:

The robustness of the proposed Reed-Solomon Code Cross Interrupt based Error Attenuate Decoder (RCCI-EAD) framework has been checked using MATLAB environment. The parametric factors based experimental evaluation is used to significantly reduce the complexity. Reed-Solomon Code, and Cross Interrupt based Error Attenuator Decoder are combined together to reduce the error correcting code and delay line codes.

Reed-Solomon Code Cross Interrupt based Error Attenuate Decoder (RCCI-EAD) framework is compared with the existing Orthogonal Frequency Division Multiplexing system that is encoded by a low-density parity-check code under a Frequency Selective Fading Channel (OFDM-FSFC) (Mi-Kyung, 2008) and Convolutional Coded (CC-OFDM) (Shu-Ming Tseng, 2012) systems. Experiment is conducted on the factors such as error correcting efficiency rate, delay line code, output

power rate on peak load and interpolation length time. RCCI-EAD framework finally improves the complexity on data line wireless communication system and provides a safer means for reducing error probability rate on wireless communication channel.

The interpolation length on OFDM channel of the proposed RCCI-EAD framework is analyzed using different data transfer rate. Experiments are conducted with the input data transfer rate between 0.8 Mbps and 3.2 Mbps and the response of the framework is investigated. The maximum interpolation length of the proposed framework is observed between 1.9 Mbps and 3.2 Mbps using all the methods.

The maximum interpolation length reaches to 58 m which declines to 51 and 48 respectively compared with the existing OFDM-FSFC (Mi-Kyung, 2008) and CC-OFDM (Shu-Ming Tseng, 2012) respectively. This is because of the application of Low-Density Parity-Check (LDPC) code,

efficiently groups with the even and odd numbered samples making 28% and 40% better comparatively

to the two other existing methods (Mi-Kyung, 2008; Shu-Ming Tseng, 2012).

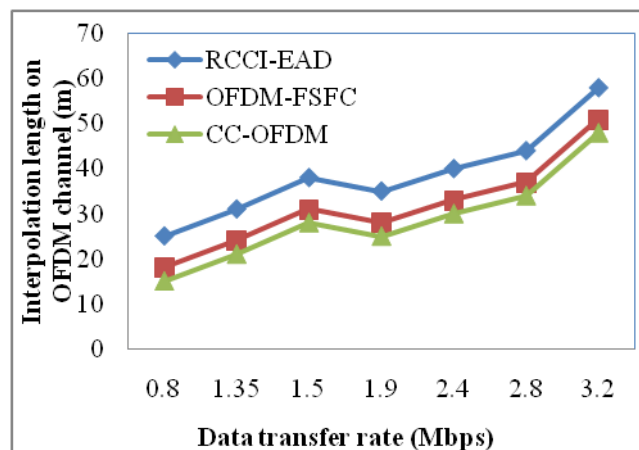


Fig. 6: Impact of interpolation length on OFDM channel

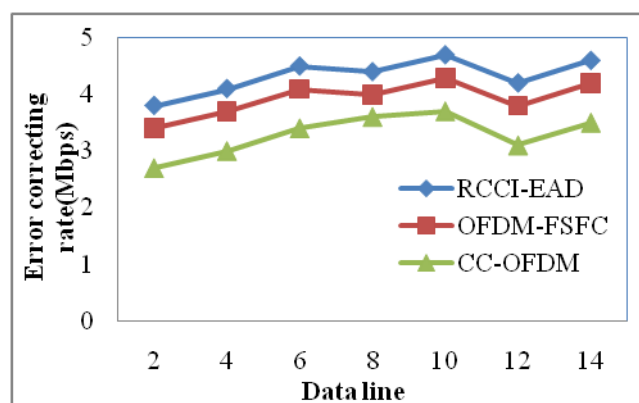


Fig. 7: Impact of error correcting rate.

To improve the error correcting rate, in this work Reed Solomon code and non-binary cyclic form using parity symbol are used which achieves higher rate of error correcting code as in Figure 7. This is because of the application of Reed Solomon code using parity symbol that efficiently manages the error correcting rate that significantly increases the error correcting rate by 8.695% and 10.52% compared to OFDM-FSFC (Mi-Kyung, 2008) and CC-OFDM (Shu-Ming Tseng, 2012) respectively.

#### Conclusion:

This paper provides an inclusive study of Reed-Solomon Code Cross Interrupt based Error Attenuate Decoder (RCCI-EAD) framework specifically used for data line systems to minimize error and handle probability rate on wireless communication channel. A prototype of varying data line and data transfer rate is simulated and tested. Simulation results show the interpolation length on OFDM channel is maximized during data transfer rate of 3.2 Mbps. The experimental measurements show that the error correcting code gets increased when the data line

varies from 2 to 14. Experiments results indicates that the proposed RCCI-EAD framework is an efficient method for providing a higher data rate and improving interpolation length on OFDM channels.

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