International Journal of Computer Application (2250-1797)
Volume 6– No.5, September- October 2016

OSTBC MODIFIED ENCODER DESIGN FOR NOISE FREE MIMO COMMUNICATION

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ABSTRACT: Proposed work show that MIMO channel in case of Space-Time Codes from quasi-orthogonal designs is transformed into an equivalent block-diagonal MIMO-channel with identical blocks having constant eigenvectors, independent of channel realization. Furthermore, proposed work show that Eigen values of each block are pair wise independent and follow a non-central chi-square distribution, where number of degrees of freedom equals four times number of receive antennas. By relaxing requirement of full diversity one arrives at second group of Space-Time Codes from quasi-orthogonal designs. MIMO systems with multiple antenna elements at both link ends are an efficient solution for future wireless communications systems as they provide high data rates by exploiting spatial domain under constraints of limited bandwidth and transmit power. Space-Time Block Coding (STBC) is a MIMO transmit strategy which exploits transmit diversity and high reliability. Space–time coding is a technique used in wireless communications to transmit multiple copies of a data stream across a number of antennas and to exploit various received versions of data to improve reliability of data-transfer this work combination of Space-Time Codes with conventional channel coding techniques is considered. New receiver structures are presented and rendering of Space-Time Codes with iterative algorithms for soft-input-soft-output-decoding is examined and optimized with help of new analytical tools, so called EXIT-charts. Furthermore, some criteria for optimal mapping strategy are derived incase of OSTBC.

Keyword: OSTBC: Orthogonal Space Time Block Coding, MIMO: Multiple Input Multiple Output OFDM: Orthogonal Frequency Division Multiplexing QSTBC: Quasi Orthogonal STBC, ISI: Inter Symbol Interference, ICI: Inter Carrier Interference.

I-INTRODUCTION

Due to an explosion of need for high-speed wireless services, such as wireless Internet, email, stock quotes, and cellular video conferencing, wireless communications it become one of most exciting fields in modern engineering. Interference from other users and inter-symbol interference (ISI) from multiple paths of one's own signal are serious forms of distortion, latter effectively causing frequency-selective channel properties. Furthermore, when transmit and receive antennas are in relative motion, Doppler Effect will spread frequency spectrum of received signals. This results in time varying channel characteristics. Many systems must function without a line-of-sight (LOS) path between transmit and receive antennas, thus pure Rayleigh fading may completely attenuate a signal at times and render a channel temporarily useless. Additionally, usual additive white Gaussian noise (AWGN) corrupts signal. Besides above difficulties, there are extremely limited bandwidth and stringent power limitations on both mobile unit (for battery conservation) and base station (to satisfy government safety regulations). To conserve bandwidth resources, proposed work maximize spectral efficiency by packing as much information as possible into a given bandwidth. A solution to bandwidth and power problem is cellular concept, in which frequency bands are allocated to small, low power cells and reused at cells far away. However, this idea alone is not enough. Proposed work must look to other means, such as space-time coding, to increase data rate, capacity, and spectral efficiency.

STBC: A typical communication system consists of a transmitter, a channel, and a receiver. Space-time coding involves use of multiple transmit and receive antennas, as illustrated in Fig. 1.1 Bits entering space-time encoder serially are distributed to parallel sub-streams. Within each sub-stream, bits are mapped to signal waveforms, which are then emitted from antenna corresponding to that sub-stream scheme used to map bits to signals is called a space-time code. Signals transmitted simultaneously over each antenna interfere with each other as they propagate through wireless channel. Meanwhile, fading channel also distorts signal waveforms. At receiver, distorted and superimposed waveforms detected by each receive antenna are used to estimate original data bits .OFDM system rendering is heavily affected by inter-carrier interference, which is caused by frequency offset between carrier oscillators of transmitter and receiver. Proposed work analytically quantifies rendering loss of space-frequency codes due to frequency offset. A new class space-frequency codes, called inter-carrier interference self-cancellation space-frequency (ISC-SF) codes, is proposed to effectively mitigate effect of frequency offsetObjective is to achieve rate-1 for more than two antennas in data communication, rate means ratio between number of symbols transmitted and time slots figure below shows four antennas and four symbols (A, B, C, D) and it can be seen it uses four time slots (T1, T2, T3, T4) to transmit, if proposed work possibly arrange these symbols in orthogonal way for only four time slots and four antennas then it will be full rate (rate-1) transmission with very less fading. Another objective is to reduce BER at receiver end.

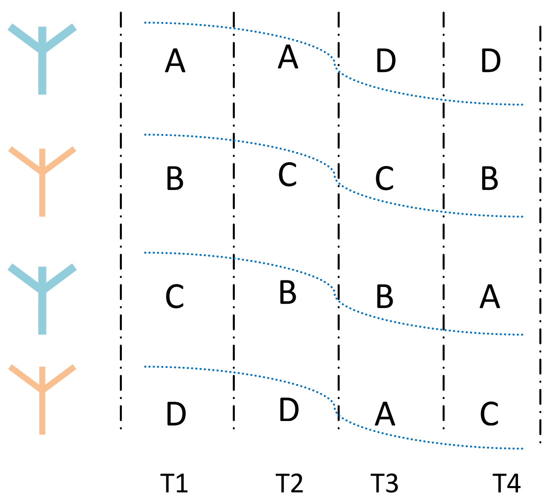

Figure 1: Space Time arrangement for Rate-1

II-LITERATURE REVIEW

Paper by	Outcomes
V. Tarokh, H. Jafarkhani	Achieve ¾ rate and firstly design a full orthogonal Encoder and decoder uses alamouti MIMO system and proposed concept of quasi orthogonal Encoder matrix.
Lei Liu, Hongzhi Zhang et al.	Good rendering as TBH and Jafarkhani with propose a Zero Forcing (ZF) decoding algorithm to reduce complexity of decoding
Abolade et al	They shown that quasi-orthogonal space-time block codes (QOSTBCs) can achieve full diversity by rotating constellations of half transmitted symbols but their work was not good when full transmitted symbols used.
Don A. S. Mindaudu	By using a genetic algorithm, rate-1 space-time block codes they achive rate-1 for more than 2 antennas, but it need huge computation as it uses genetic algorithm so throughput decreases significantly.
Jitendra Kumar Daksh et al	They use Space Time Trellis Coding (STTC) Whereas turnout of STBC with 256-QAM for rate-1 in more than two antennas, but it requires additional power.
Ankit Pandit et al	Use 4PSK and 4QAM in 4x4 MIMO Systems, achieve. better BER then previous work but was limited for 4PSK only
K.V.N. Kavitha et al.	They use frequency selective fading environment STBC OFDM and achieves good BER but comes at a cost of increased decoding complexity and delay.
Keeth Saliya Jayasinghe	By using finite-dimensional random-matrix theory, they have derived statistical properties of SNR at receiver but
Lennert Jacobs and Marc Moeneclaey	They proposed their new Encoder matrix which they prove less BER then all previous work, it was quasi orthogonal.

Table 1- literature work observations

Problem Formulation: With knowledge of stochastic nature of resulting equivalent channel due to employment of OSTBC in a MIMO system, loss in mutual information of OSTBC in subject to transmission rate, number of receive antennas and channel rank was quantified , whereas in a comparison of OSTBC with a system applying beam-forming was presented. Unfortunately, Alamouti space-time code for two transmit and one receive antennas is only OSTBC, which, to best of our knowledge, achieves maximum possible mutual information of a MIMO system , since proposed work cannot construct an OSTBC with transmission rate equal one for more than two transmit antennas . Therefore, designed a quasi-orthogonal space-time block code (QSTBC) with transmission rate one for four and eight transmit antennas. By properly choosing signal constellations as, it is possible to improve BER rendering with ML-detection for codes given in BER rendering of QSTBC with suboptimal detectors it been examined. rendering of QSTBC with respect to outage mutual information (OMI) for special case of one receive antenna and four or eight transmit antennas was examined via simulations and it was shown, that QSTBC are capable to achieve a significant portion of MIMO-OMI. Furthermore That QSTBC in conjunction with optimal (nonlinear) and suboptimal (linear) detectors provide a tradeoff between rendering and complexity.

III-IMPLEMENTATION

Alamouti Code: Consider designing a square space-time codes utilizing two transmit antennas. Most general form of this space-time code is given by

$$S = \begin{bmatrix} a11 & a12 \\ a21 & a22 \end{bmatrix}$$

Where aij are complex symbols. Note $S^H S$ it following form.

$$S^H s = \begin{bmatrix} a11^* & a21^* \\ a12^* & a22^* \end{bmatrix} \begin{bmatrix} a11 & a12 \\ a21 & a22 \end{bmatrix}$$

$$S^H s = \begin{bmatrix} |a11|^2 + |a21|^2 & a11^* a12 + a21^* a22 \\ a12^* a11 + a22^* a21 & |a12|^2 + |a22|^2 \end{bmatrix}$$

Code is orthogonal only if $S^H S$ is diagonal, i.e., when $a_{11}^* a_{12} + a_{21}^* a_{22} = 0$. Thus most general form of a 2 transmit antenna orthogonal code is in given by $a_{22} = -a_{11}^* a_{12} / a_{12}^*$,

$$S = \begin{bmatrix} a11 & a12 \\ a21 & -a11^*/a12^* \end{bmatrix}$$

Observe that this code matrix is a function of three symbol variable. By setting $a_{21} = -a_{12}^*$ proposed work obtain well *known Alamouti* code,

$$S = \begin{bmatrix} a11 & a12 \\ -a12^* & a11^* \end{bmatrix}$$

According to analysis of existing transmission matrices of quasi-orthogonal space-time block codes (STBC), proposed work generalize some of their characters and derive several new patterns to enrich family of quasi-orthogonal STBC. And to achieve further reduction in BER and analyses it and to achieve full transmit diversity.

Solution Methods: Proposed work knows positions of correlated values do not affect BER. Therefore, now proposed work derives some new matrices with different positions of correlated values from distribution of conjugates in bottom of transmission matrices. STBC can efficiently achieve transmit diversity to combat fading. By using orthogonality of transmitted symbols, Alamouti first defined a space time transmission matrix as:

$$A_{12} = \begin{bmatrix} X_1 & X_2 \\ -X_2^* & X_1^* \end{bmatrix}$$

Based on Alamouti orthogonal STBC, proposed gave a quasi-orthogonal STBC form for four transmit antennas as:

$$C_J = \begin{bmatrix} A_{12} & A_{34} \\ -A_{34}^* & A_{12}^* \end{bmatrix} = \begin{bmatrix} X_1 & X_2 & X_3 & X_4 \\ -X_2^* & X_1^* & -X_4^* & X_3^* \\ -X_3^* & -X_4^* & X_1^* & X_2^* \\ X_4 & -X_3 & -X_2 & X_1 \end{bmatrix}$$

Its character matrix it similar fashion as sparse matrix pattern, and proposed work can write it as:

$$C_J^H C_J = \begin{bmatrix} a & 0 & 0 & B_J \\ 0 & a & -B_J & 0 \\ 0 & -B_J & a & 0 \\ B_J & 0 & 0 & a \end{bmatrix}$$

Where C^H is Hermiston of matrix C, a= $\sum_{i=1}^{4} x_i^2$, and correlated value is $b_J = (x_1 x_4^* + x_1^* x_4) - (x_2 x_3^* + x_3^* x_2)$ a real number, and it is lesser compare with available

QSTBC methods to reduce BER. Rendering for new mentioned matrices give better result when compared with TBH, Jafarkhani, TBH correlated to Jafarkhani, Jafarkhani correlated to TBH & above mentioned matrices. And also on basis of above mentioned matrix proposed work has calculated BER for different PSK systems.

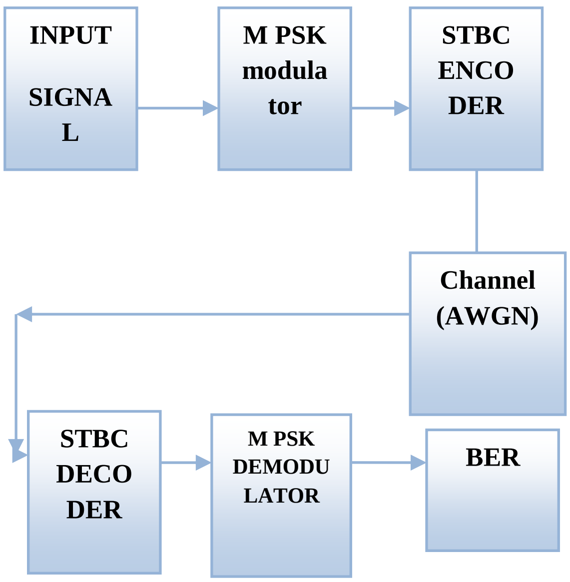

Figure 2 System Model

System model consists of a input signal, M PSK modulator, STBC encoder , AWGN channel, STBC decoder, M PSK demodulator & BER .AT transmitter end signal is first modulated by using M PSK modulator then it is encoded using STBC encoder, ,illustrated in Fig. 5.1 Bits entering space-time encoder serially are distributed to parallel sub-streams. Within each sub-stream, bits are mapped to signal waveforms, which are then emitted from antenna corresponding to that sub-stream scheme used to map bits to signals is called a space-time code. Signals transmitted simultaneously over each antenna interfere with each other as they propagate through AWGN channel. At receiver distorted and superimposed waveforms detected by each receive antenna are used to estimate original data bits.

IV-RESULT

Figure 3and 4 Proposed model bit error rate is less then TBH and all other , simulation is for 4 PSK & 16 PSK modulation technique, here simulation results shows that STBC encoder technique when used wih Jafarkhani encoding scheme is less efficient then TBH encoding scheme and Jafarkhani with TBH correlated position is near to TBH response. When modulated on 4 PSK TBH Correlated with Jafarkhani is having less BER than Jafarkhani with TBH correlated position &proposed model is having less bit error rate then TBH Correlated with Jafarkhani

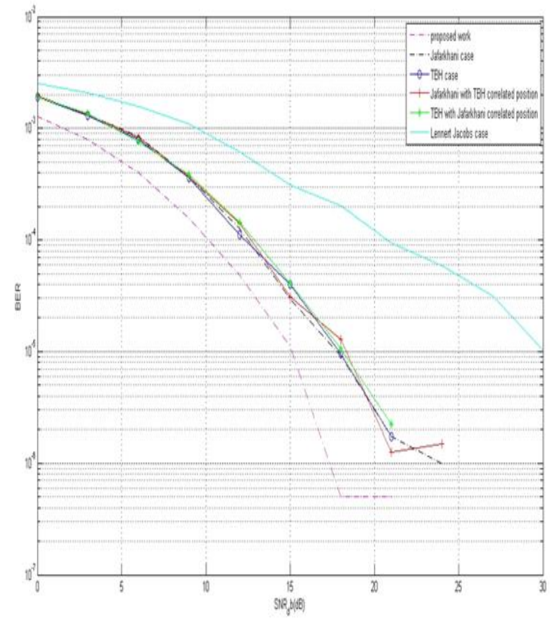

Figure 3 BER analyses for 4 PSK using proposed model

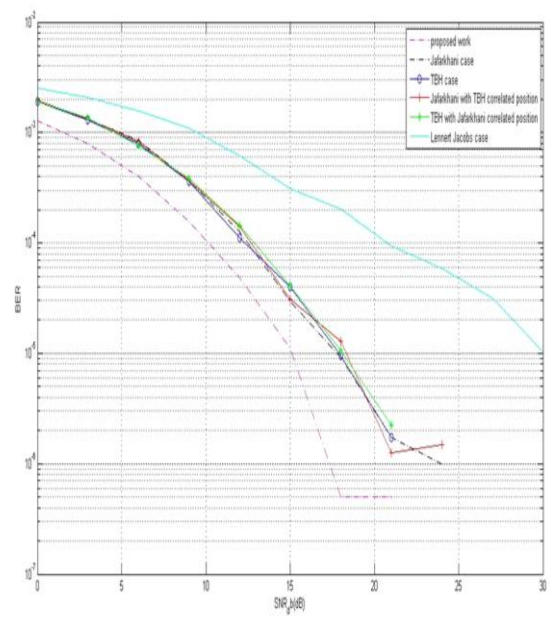

Figure 4 BER analysis for 16 PSK using proposed model

simulation is been taken for noisy signal of SNR value range from 0db to 30 db and been tested with available modals Jafarkhani, TBH, Jafarkhani with TBH correlated position, TBH Correlated with Jafarkhani base papers modal and proposed modal.

SNR in db	BER in **Lennert Jacobs** modal $x10^{-3}$	BER in proposed modal $x10^{-4}$
0	0.513750000000	0.44000000000000
3	0.279500000000	0.13750000000000
6	0.153250000000	0.02000000000000
9	0.084750000000	0
12	0.035750000000	0
15	0.014750000000	0
18	0.015750000000	0
21	0.003000000000	0
24	0.003500000000	0
27	0.001250000000	0
30	0.000500000000	0

Table 2 -BER Comparison

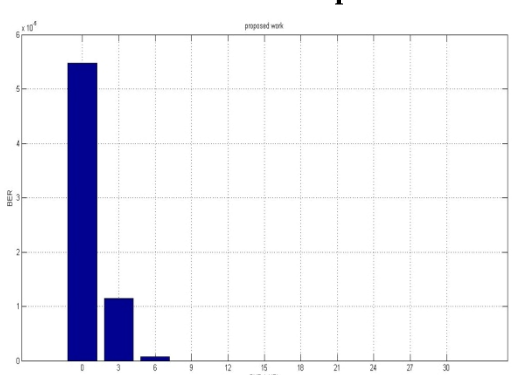

Figure 5 BER in proposed modal

It can be clearly observed that proposed work causes very small amount of BER in case of highly noisy signal but in case of 0 to 6 db it did not generates any BER but all other available modals and base paper modals did produces BER more than proposed work at any kind of less or highly noisy signal. Proposed modal uses quasi orthogonal coding and that gives such a good results also proposed work is been design with combination of Jafarkhani correlated with base work. It can be said that proposed modal is a full rate less BER modal, full rate signifies that four symbols will transfer in four time slots.

BER x10^-3	SNR in Lennert Jacobs modal	SNR in proposed modal
0.0005	4	18
0.0025	3	15
0.0045	2	12

Table 3- SNR observed for different BER observation

It can be clearly observed that SNR in proposed work is highest at any BER data communication situation and SNR is around 60% better than base paper work and with all four standard cases.

V-CONCLUSION

Generally, based on a unitary pattern idea from [1], this project examines character matrices of quasi-orthogonal STBC and derives several new codes to enrich their family. New codes have different positions of correlated values in character matrices by changing distribution of conjugates in transmission matrices. In addition, some of them can improve BER with a simple optimizing scheme. Proposed work has designed space-time codes for MIMO systems considering practical constraints such as decoding complexity and system imperfections. While reduction in decoding complexity leads to power and manufacturing cost savings, maintain system imperfections is necessary to prevent possible transmission errors. Necessary and sufficient conditions for low decoding complexity STBC are proposed for quasi-static frequency-flat MIMO fading channels. To achieve low complexity, proposed work has developed multi-group decodable STBC. For a fixed number of transmitted symbols encoded in a code matrix, an increase in number of groups leads to lower decoding complexity. Proposed work created square, orthogonal, full rate and full diversity space-time code for 4 transmit antennas with complex M-PSK based constellations. At first, it appears new code with PSK base symbols. It states that square complex orthogonal designs with full rate and diversity cannot exist, meaning that a general code cannot exist for all possible symbol constellations. However, one may exist for a specific restricted constellation. For example, note when complex symbols are confined to real line (i.e., for real symbols), orthogonal designs exist for 4 and 8 transmit antennas. New orthogonal code with PSK symbols is significant as an existence result, and motivates search for similar codes with better rendering. A code that is only orthogonal or only it full diversity for specific constellations is still very practical. Desired data rate of a communication system is typically known, allowing a system designer to customize a full rate, full diversity code tailored to meet his specifications.

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