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A DESIGN OF MODIFIED SSTBC ENCODER TO NOISE FREE MIMO COMMUNICATION IN OFDM

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ABSTRACT: In order to utilize huge potential of multiple antenna concepts, it is necessary to resort to new transmit strategies, referred to as Space-Time Codes, which, in addition totime&spectral domain, also use spatial domain, proposed work show that MIMO-channel in case of Space-Time Codes from semi-orthogonal designs is transformed into an equivalent block-diagonal MIMO-channel with identical blocks, independent of channel realization. Furthermore, proposed work show represents a generalization of Space-Time Codes from orthogonal designs. Particularly, that not only Alamouti-scheme, an OSTBC to two transmits antennas,with full rate of data communication however also its generalized version achieves capacity in case of two transmit and two receive antenna only. Proposed SSTBC encoder is examined with respect to error rate rendering& spectral efficiency with optimal MIMO communication structure and found less BER as previous designs. In second part of this work combination of Space-Time Codes with conventional channel coding techniques is considered.

Keywords: OSTBC: Orthogonal Space Time Block Coding, MIMO: Multiple Input Multiple Output, SISO: Single Input Single Output, STTC: Space Time Trellis Coding, SSTBC: Semi Space Time Block Coding.

I-INTRODUCTION

Orthogonal frequency-division multiplexing (OFDM) is a procedure of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme to wideband digital communication, used in applications like digital television & audio broadcasting, DSL Internet access, wireless networks, power-line networks, &4G mobile communications. Orthogonal frequency division multiplexing (OFDM) is considered as a one of best modulation schemes in wireless communications. However, OFDM suffers from sensitivity to frequency offset. This frequency offset introduces problem of inter-carrier interference (ICI) in OFDM system.Space-time block codes, which are an important class of space-time codes, have been studied extensively recently. They are expected to play a prominent role in both third generation & beyond wireless standards. Proposed work considers linear STBC, in which, space-time code matrix is linear with respect to data symbols & its conjugates. In following, proposed work use notation STBC to imply linear STBC where no confusion may arise.

II-LITERATURE REVIEW

Later on in2011Lennert Jacobs [6] published Analysis and Efficient Evaluation of the BER of OSTBCs With Imperfect Channel Estimation in Arbitrarily Correlated Fading Channels analysis of the exact bit error rate (BER) performance of orthogonal space-time block codes (OSTBCs) with maximum-likelihood detection in the presence of channel estimation errors is presented, Later on in 2013 Lennert Jacobs [5] published Accurate BER Approximation for OSTBCs With Estimated CSI in Correlated Rayleigh Fading. Present a novel closed-form bit error rate (BER) approximation for orthogonal space-time block codes employing rectangular quadrature amplitude modulation. In same year Ankit Pandit et al [4] published BER Analysis of Various STBC Coding for MIMO Systems at Different Modulation Schemes, This Paper shows the performance analysis of Bit Error Rate (BER) in MIMO system using STBC codes. In same year Khushbu Sethi et al [3] published performance Evolution of Different Space Time Block Codes with

Linear Receiver, they provide the description of different type of space time block codes and to provide the performance analysis of these codes without channel knowledge at the transmitter with different schemes for four transmit and one receive antenna. Insame year Beng Soon Tan et al[2], published Performance Analysis of Orthogonal Space-Time BlockCode With Minimum-Selection Generalized Selection Combining Receiver Over Rayleigh Fading In this paper, An orthogonal space-time block code (OSTBC) with a minimum-selection generalized selection combining (MS-GSC) receivers proposed and analyzed. At last in 2013 Shailendra Kumar Mishra et al [1] published BER Comparison of 4 × 4 and 8 × 8 Alamouti MIMO Systems in the Presence of Channel Estimation Errors, This paper will be dealing with receiver antenna selection to reduce implementation complexity. A new Space Time Sum of Squares (STSoS) combining selection diversity is used,which has much simpler implementation and provides improved Bit Error Rate (BER) performance. The effects of channel estimation errors on this selection scheme are examined.

Paper by	Method	BER
Shailendra Kumar Mishra et al [1]	4x4 OSTBC with Space Time Sum of Squares (STSoS) on 4x4 Space time ratio (rate-1)	*0.400 5x10-3*
Beng Soon Tan et al [2]	4x4 OSTBC with a minimum-selection generalized selection combining (MS-GSC) (rate-1)	*0.508 25 x10-3*
Khushbu Sethi et al [3]	4x4 Quasi –OSTBC with Zero forcing receiver with new 4x4 fadding matrix on 4x4 Space time ratio (rate-1)	*0.505 5 x10-3*
Mr. Ankit Pandit rt al [4]	Zero-Forcing (ZF) & STTC based 4x4 QOSTBC with new 4x4 fadingmatrix (rate-1)	*0.385 5 x10-3*
Lennert Jacobs et al [5]	Monte Carlo simulations done on mismatched maximum-likelihood receiver based 3x3 OSTBC with 3x4Space time ratio (rate-3/4)	*0.749 75 x10-3*

Table 1 literature work observations

Lennert Jacobs et al [5][6] did work on rate ¾ which is slower than rate-1 communication and not suitable for 4G data communication however it can have less BER in special scenario. Ankit Panditet al [4] they use Zero forcing receiver based MIMO communication which helps to maintain orthogonality in OFDM communication, they achieved QOSTBC with rate -1 but their work was having less BER and slow receiver.Khushbhu sethi et al [3] they use Viterbi encoder instead of STBC encoder which is less efficient in maintaining orthogonality & they use 2x2 MIMO communication only not use lot than two antennas. Proposed work is using 4x4 antennas & QSTBC to designing of Encoder.Beng Soon Tan et al [2] work BERT implemented its work on MATLAB with a minimum-selection generalized selection combining (MS-GSC) with (rate-1) problem with its work is that they use its work to quasi orthogonal with four antennas and with only four orthogonal pair columns.Shailendra Kumar Mishra et al [1] use Space Time Sum of Squares (STSoS) encoder for data communication and achieved rate-1 communication but still their work was not fully orthogonal their work was quasi orthogonal and that cause less BER.

III-PROPOSED ORTHOGONAL STBC

Proposed design is basically use another solution procedure of achieving orthogonality& use quasi-orthogonal fading matrix & also proposed work is achieving full rate (rate-1). Proposed design has a new fading matrix & use DWT instead of FFT also proposed design has less BER as compare with old standard methods. Coding of design is being explained below. These codes exhibit partial orthogonality&provide only part of diversity gain mentioned above.

$$C_{4,1} = \begin{matrix} s_1 & s_2 & s_3 & s_4 \\ -s_2^* & s_1^* & -s_4^* & s_3 \\ -s_3^* & -s_4^* & s_1^* & s_2^* \\ s_4 & -s_3 & -s_2 & s_1 \end{matrix}$$

Orthogonality criterion only holds to columns (1&2), (1&3), (2&4)&(3&4). Crucially, however, code is full-rate&still only necessary linear processing at receiver, although decoding is slightly lot complex

than to orthogonal STBCs. Results show that this Q-STBC outperforms (in a bit-error rate sense) fully-orthogonal 4-antenna STBC over a good range of signal-to-noise ratios (SNRs).

IV-RESULT OF PROPOSED STBC CODE

Figure below shows proposed model bit error rate is less than all other simulation is in order to 4 PSK modulation technique, here simulation results shows that STBC encoder technique when used with shailendra kumar[1] encoding scheme is less efficient then Beng soon[2] encoding scheme, Khushbhu sethi[3] encoding scheme, ankit pandit[4] encoding scheme and lennert jecobs[5][6] encoding scheme.

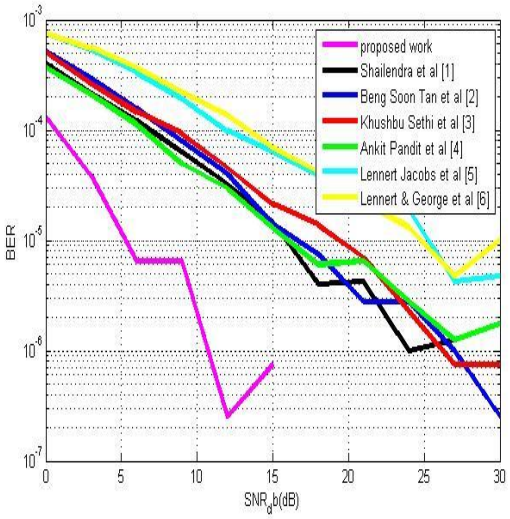

Figure 1: BER study in order to 4 PSK using proposed model.

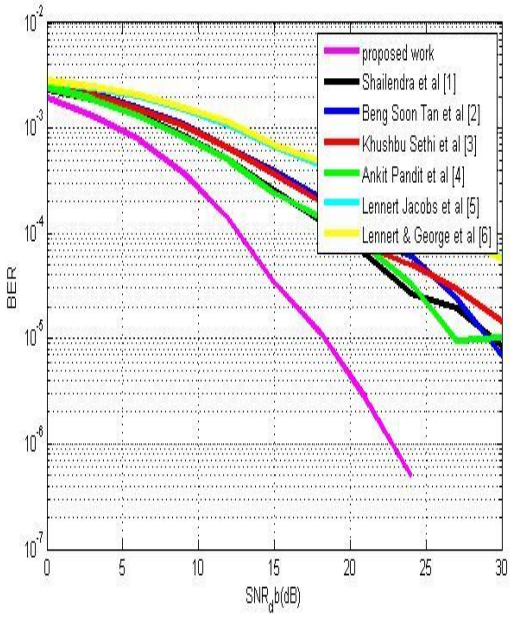

Figure 2: BER study in order to 16 PSK using proposed model

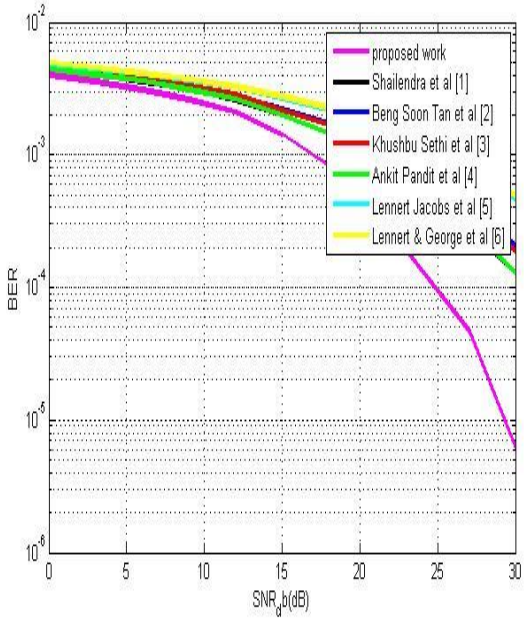

Figure 3: BER study in order to 64 PSK using proposed model

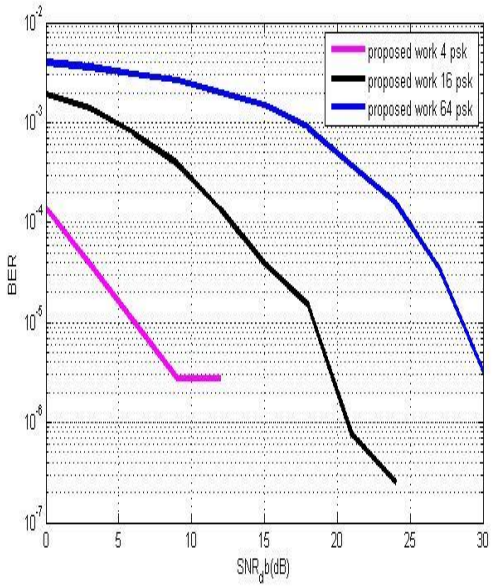

Figure 4: BER in proposed work with 4, 16 & 64 PSK Modulation

Simulation is been taken in order to noisy signal to SNR value range from 0db to 30 db&have been tested with available models J shailendra kumar[1] encoding scheme Beng soon[2] encoding scheme, Khushbhu sethi[3] encoding scheme, ankit pandit[4] encoding scheme and lennert jecobs[5][6] encoding scheme &proposed model. Table below shows comparative results among all available models. Coding is being done to a random input signal&amount of noise is been selected with its db value range from 0db to 30 db with step size of 3db, means first0db noise will be added into signal&after applying OSTBC, BER is been calculated in-between original signal&signal after decoding using OSTBC&same method will be carried out to 3db noise&6db noise&so on.

SNR in db	Shailendra Kumar Mishra et al [1] *10^-3	Beng Soon Tan et al [2] *10^-3	Khushbu Sethi et al [3] *10^-3	Ankit Pandit et al [4] *10^-3	Lennert Jacobs and Marc Moeneclaey [5] *10^-3	Lennert Jacobs, George C. Alexandropoulos et al [6] *10^-3	Proposed work *10^-3
0	*0.4005*	*0.508250*	*0.5055*	*0.3855*	*0.74975*	*0.78275*	*0.13925*
3	*0.2170*	*0.2770*	*0.32025*	*0.20575*	*0.51275*	*0.54600*	*0.03925*
6	*0.1155*	*0.16075*	*0.16375*	*0.102000*	*0.31325*	*0.336750*	*0.0080*
9	*0.05225*	*0.08675*	*0.07425*	*0.060250*	*0.2140*	*0.21700*	*0.00350*
12	*0.02650*	*0.0470*	*0.0490*	*0.02525*	*0.10850*	*0.13200*	*0.00050*
15	*0.0130*	*0.02225*	*0.02225*	*0.0105*	*0.05925*	*0.06475*	*0.00025*
18	*0.01050*	*0.0120*	*0.00750*	*0.0065*	*0.03750*	*0.03550*	*0*
21	*0.0030*	*0.00575*	*0.0010*	*0.0035*	*0.02675*	*0.022750*	*0*
24	*0.00250*	*0.0010*	*0.002250*	*0.0010*	*0.01750*	*0.014250*	*0*
27	*0.001250*	*0.00050*	*0.001750*	*0*	*0.0060*	*0.005750*	*0*
30	*0*	*0*	*0.00175*	*0.00150*	*0.0070*	*0.003500*	*0*

Table 2: Comparative results

The OSTBC scheme in proposed code are shailendra kumar[1] encoding scheme Beng soon[2] encoding scheme, Khushbhu sethi[3] encoding scheme, ankit pandit[4] encoding scheme and lennert jecobs[5][6] encoding scheme&finally to proposed encoding method.Signal&amount of noise has been taken same to encoding techniques.

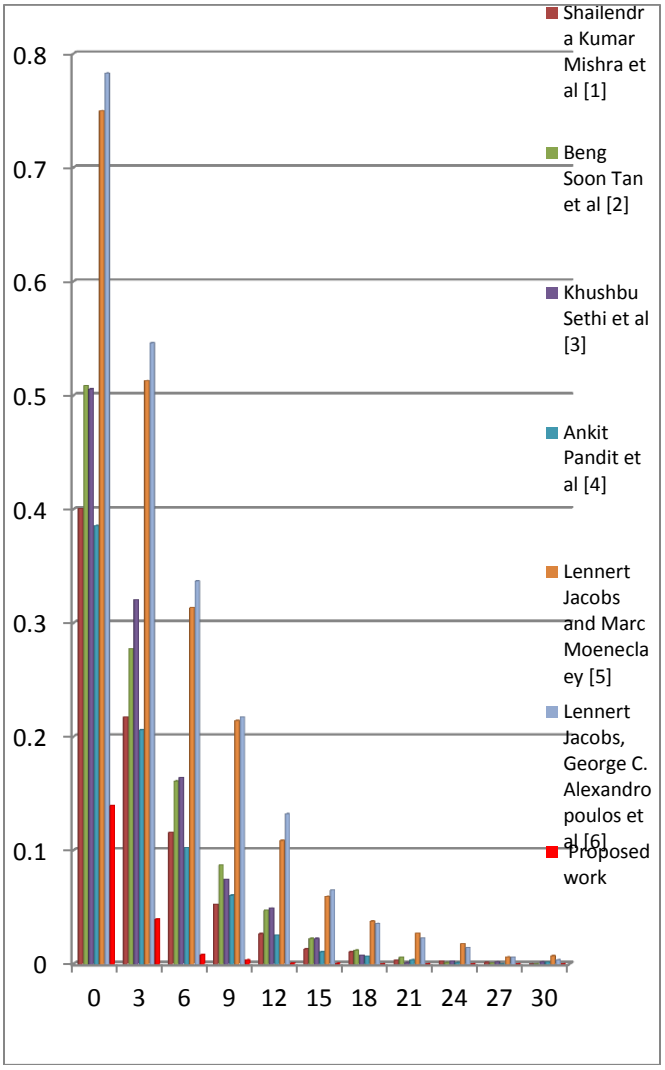

Figure 5: BER Comparative graphs

It may be clearly observed from figure 5.6 that proposed work causes very small amount of BER in case to highly noisy signal, however in case to less noisy signal it did not generates any BER however all other available models&base paper models did produce BER lot than proposed work at any kind of less or highly noisy signal. Proposed model uses quasi orthogonal coding&that gives good results. Also, proposed work is been designed with combination of jafarkhani code correlated with base work. It may be said that proposed model is a full rate BER model, full rate signifies that four symbols will transfer in four time slots.

BER x10 ^-3	Shailendra Kumar Mishra et al [1]	Beng Soon Tan et al [2]	Khushbu Sethi et al [3]	Ankit Pandit et al [4]	Lennert Jacobs and Marc Moeneclaey [5]	Lennert Jacobs, George C. Alexandropoulos et al [6]	Proposed work
0.0025	*24*	*15*	*15*	*21*	39	36	10
0.139	*6*	*6*	*6*	*6*	*12*	*12*	0

Table 3: SNR observed in order to various BER observations

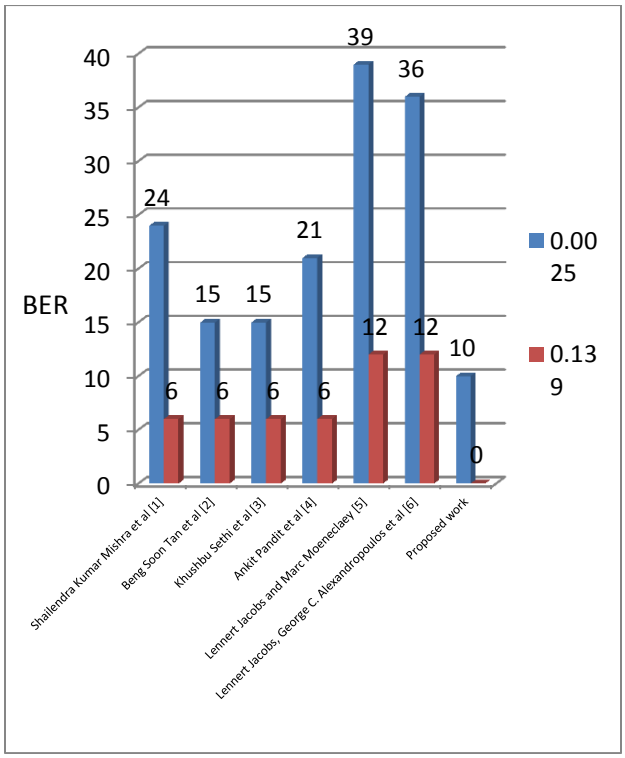

Figure 6: Comparative SNR results

It may be observed fromfigure 5.7&table 5.2 above that SNR observed to propose OSTBC encoder is highest at various amount of BER. Here first BER is fixed at 0.005&SNR amount at that particular BER is observed to all test scenarios of base works&then BER is fixed at 0.0025&then at 0.0045&results are observed. It may be clearly observed from figure

above that SNR in proposed work is highest at any BER data&is better than base paper work&with all four standard cases.

V-CONCLUSION

Proposed work has designed space-time codes in order to MIMO systems considering practical constraints like decoding complexity&system imperfections. While reduction in decoding complexity leads to less BER and High SNR, maintaining system imperfections is necessary to prevent possible transmission errors. Necessary&sufficient conditions in order to low decoding complexity SSTBC are proposed in order to quasi-static frequency-flat MIMO fading channels. To achieve low complexity, proposed work has developed multi-group decodable STBC. In order to a fixed number to transmitted symbols encoded or Rate-1 in a code matrix, an increase in number of groups leads to a lower decoding complexity.

From new class II non-linear orthogonal code to proposed work created square, orthogonal, full rate&full diversity space-time code in order to 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&diversity cannot exist, meaning that a general code cannot exist in order to all possible symbol constellations. However, one may exist in order to a specific restricted constellation. In order to example, note when complex symbols are confined to real line (i.e., in order to real symbols), orthogonal designs exist in order to 4&8 transmit antennas. New orthogonal code with PSK symbols is significant as an existence result,&motivates searching order to similar codes with better rendering.

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