A Novel Strategy for Performance Improvement of MISO Wireless System using Alamouti STBC with 4th Order FIR Filter

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ABSTRACT
The wireless communication system is highly desirable field among the researchers these days because of the increasing demand of high speed of networks to serve on the next generation mobile devices. The various researches already completed but the reliability like leased line hasn't achieved yet. The end to end performance of the system still needs to be improved. In this paper same we are trying to improve. The figure of merit is Bit Error Rate (BER). The proposed approach depends on multiple input single output (MISO) system which significantly improves the performance. Now to improve more the Alamouti STBC with 4th Order FIR filter is implemented. The filtering approach have changed picture of the system by reducing the error probability. BER performance achieved in this paper is better than existing work.

Keywords
Alamouti STBC, MISO, FIR Filter, QAM Modulation.

1. INTRODUCTION
These days the Demands for higher transmission rates in a reliable way is increased as wireless networks start to offer video and voice transmission in addition to the data transmission. Thus, recently, next-generation wireless networks have emerged to offer higher transmission rates with less transmission errors through the use of multiple antennas. Multiple antenna systems increase the reliability and spectral efficiency of the system through the use of diversity techniques and SM scheme, respectively. Diversity techniques are widely used to reduce the effect of multi-path fading. The probability of all the replicas of the same information symbol experiencing the same fading decreases as the number of diversity branches increase. In [1], a basic transmit diversity scheme is developed for two transmit antennas, while in [2] the diversity gain is increased with using more than two antennas and employing orthogonal codes. In these works, the channel is assumed to be uncorrelated and at the receiver maximum-likelihood detection is employed together with combining techniques. On the other hand, the spectral efficiency of the system is increased by employing spatial multiplexing (SM) [3] which permits the opening of multiple spatial data pipes between transmitter and receiver without any additional bandwidth or power requirement.

Most work on wireless communications had focused on having an antenna array at only one end of the wireless link, typically at the receiver. Seminal papers by Foschini and Gans [4], Foschini [3] and Telatar [6] enlarged the scope of wireless communication possibilities by showing that when antenna arrays are used at both ends of a link, substantial capacity gains are enabled by the highly-scattering environment. Many established communication systems use receive diversity at the base station. For example, Global System for Mobile communications (GSM) [5] base station typically has two receive antennas. This receive technology is used to improve the quality of the uplink from mobile to base station without addition of any cost, size or the power consumption to the mobile [7]. Reference [8] has generally discussed the use of receive diversity in cellular system and its impact on the system capacity. Receive diversity was largely studied and used until Foschini's 1998 paper [1].

Space-time Codes:
Space-time code (STC) is a method usually employed into wireless communication systems to improve the reliability of data transmission using multiple antennas [1, 2]. STCs rely on transmitting multiple copies, redundant copies of a data stream to the receiver in the hope that at least some of them will survive the physical path between transmission and reception in a good state to allow reliable decoding.

Space-time Block Codes:
Space-time block codes (STBC) are a generalized version of Alamouti scheme [2] [9] [10]. These schemes have the same key features. Therefore, these codes are orthogonal and can achieve full transmit diversity specified by the number of transmit antennas. In another word, space-time block codes are a complex version of Alamouti's space-time code in [1], where the encoding and decoding schemes are the same as there in the Alamouti space-time code in both the transmitter and receiver sides and the data are constructed as a matrix which has its rows equal to the number of the transmit antennas and its columns equal to the number of the time slots required to transmit the data. At the receiver section, when signals are received, they are firstly combined and then sent to the maximum likelihood detector where the decision rules are applied. Space-time block codes were designed to achieve the maximum diversity order for the given number of transmit and receive antennas subject to the constraint of having a simple linear decoding algorithm. This has been made space-time block codes a very poplar scheme and most widely used.

2. PROPOSED METHODOLOGY
Wireless communication system needs the higher data rate which demands lower bit error probability that's trying to done in this paper. The proposed system utilized the space time coding and FIR Filtering technique with very useful less complex MISO space diversity. The block diagram of the proposed methodology is shown in the given Fig. 1 below.

The main blocks are data as a input which is modulated by 16-QAM modulation technique than a space time coding is added with the signal. Now before transmission of the signal MISO channel need to be initialized. The AWGN channel is considered transmission channel, during transmission noise is added to the signal. The noisy signal is received at the receiver side first the Alamouti STBC is removed after that the demodulation is applied. For better error probability filter is applied which is 4th order FIR Filter.

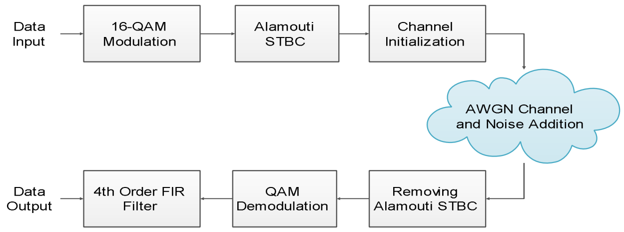


Fig. 1 Block Diagram of Proposed Methodology

The simulation of the above proposed system is implemented on simulation tool and the algorithm is shown in the below Fig. 2.2. The simulation steps are:

Start the simulation

Initialize the environmental variables

Generate data for transmission

Modulate data with 16-QAM scheme

Apply Alamouti STBC

The channel need to be initialized

Transmit signal through AWGN channel and adding Noises

Remove STBC from Signal

Demodulate signal with 16-QAM

Apply 4th Order FIR Filter

Calculate BER and display results

End of simulation

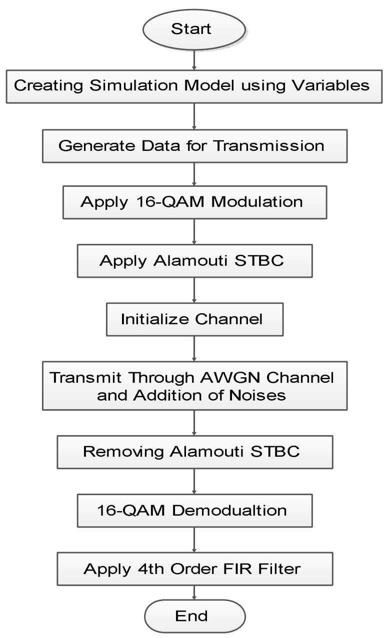


Fig. 2.2 Flow Chart of Proposed Simulation Algorithm

3. SIMULATION RESULTS

The proposed system is implemented on the Matlab R2011a and the results of the implemented algorithm are calculated in terms of Bit Error Rate (BER) vs Signal to Noise Ratio (SNR). BER vs. SNR curve calculated for three modulation techniques 16-QAM, 32-QAM and 64-QAM and from the results it has been shown that 16-QAM better with Alamouti STBC with Multiple Input Single Output (MISO) (i.e. 2x1) system.

In the Fig. 3.1 system performance is evaluated with above mention system. To improve the performance of the system the proposed approach utilized the FIR filter with the same system. Now from the result it can be say that with the use of 2nd order FIR filter performance of the system significantly improved. Now if the order of the FIR filter increased to 4th order than it enhanced more as shown in the given Fig. 3.3.

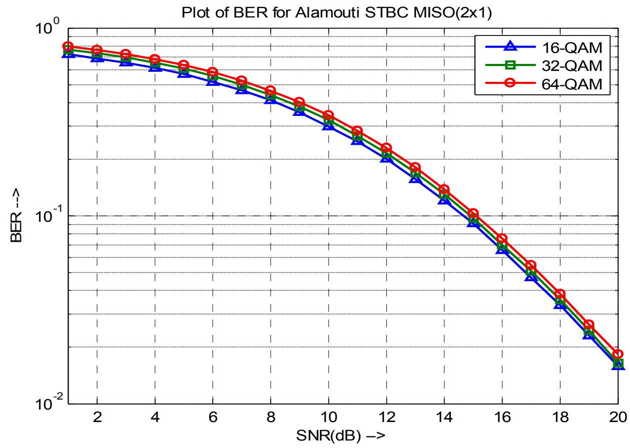
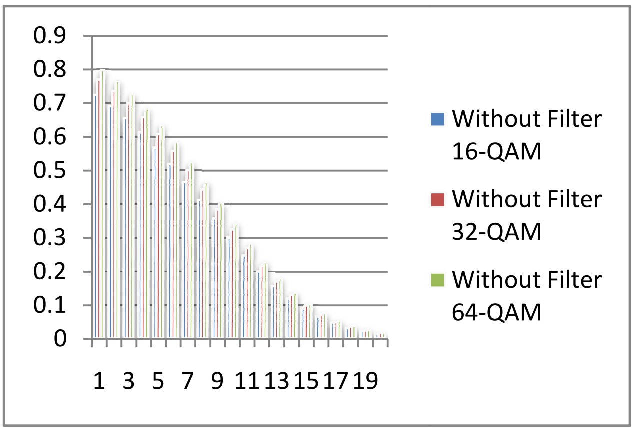


Fig. 3.1 BER vs SNR curve for MISO with Alamouti STBC coding with QAM Modulation

SNR	Without Filter		
	16-QAM	32-QAM	64-QAM
1	0.7235	0.7695	0.7974
2	0.6901	0.7354	0.7653
3	0.6542	0.6999	0.7271
4	0.6128	0.657	0.683
5	0.5675	0.6077	0.6348
6	0.5188	0.5572	0.5829
7	0.4647	0.5003	0.5246
8	0.4116	0.443	0.4641
9	0.3562	0.3838	0.4037
10	0.301	0.3239	0.3421
11	0.2472	0.2686	0.2826
12	0.1993	0.2163	0.2276
13	0.1569	0.1701	0.1794
14	0.1197	0.1299	0.138
15	0.0896	0.0981	0.1034
16	0.0652	0.0714	0.0754

17	0.0468	0.0505	0.0535
18	0.0324	0.0356	0.0382
19	0.0226	0.0247	0.0263
20	0.0152	0.0165	0.018



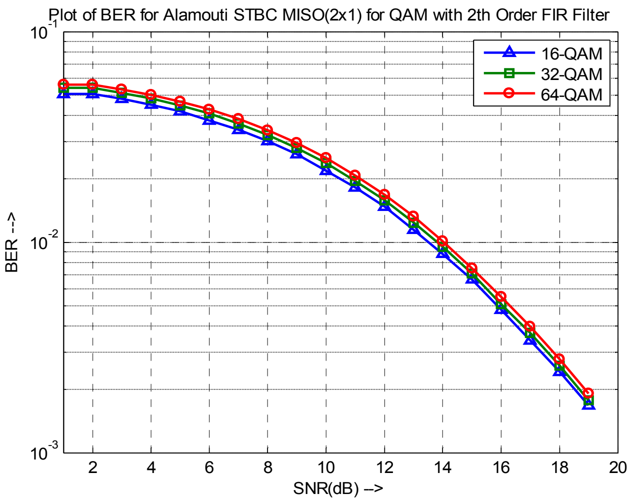
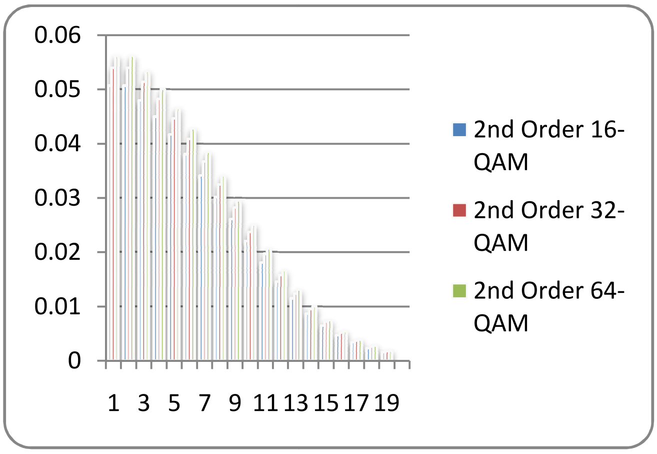


Fig. 3.2 BER vs SNR curve for MISO, Alamouti STBC coding and 2nd Order FIR Filter with QAM Modulation

SNR	2nd Order		
	16-QAM	32-QAM	64-QAM
1	0.0507	0.054	0.0562
2	0.0507	0.054	0.0562
3	0.048	0.0514	0.0534
4	0.045	0.0482	0.0501
5	0.0417	0.0446	0.0466
6	0.0381	0.0409	0.0428
7	0.0341	0.0367	0.0385
8	0.0302	0.0325	0.0341
9	0.0261	0.0282	0.0296
10	0.0221	0.0237	0.0251
11	0.0181	0.0197	0.0207
12	0.0146	0.0158	0.0167

13	0.0115	0.0124	0.0131
14	0.0087	0.0095	0.0101
15	0.0065	0.0072	0.0075
16	0.0047	0.0052	0.0055
17	0.0034	0.0037	0.0039
18	0.0023	0.0026	0.0028
19	0.0016	0.0018	0.0019
20	0	0	0



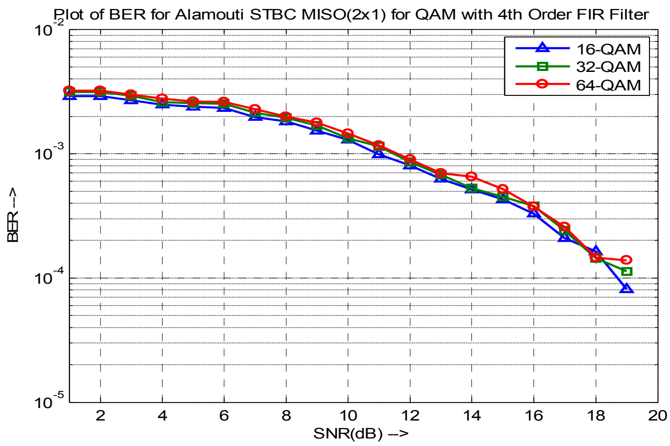
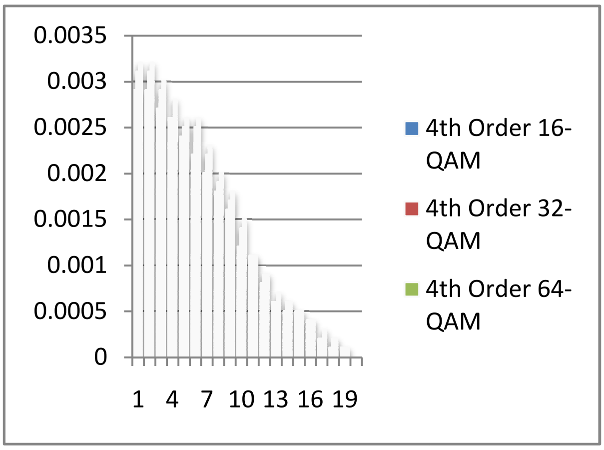


Fig. 3.3 BER vs SNR curve for MISO, Alamouti STBC coding and 4th Order FIR Filter with QAM Modulation

SNR	4th Order		
	16-QAM	32-QAM	64-QAM
1	0.0029	0.0031	0.0032
2	0.0029	0.0031	0.0032
3	0.0027	0.0029	0.003
4	0.0026	0.0026	0.0028
5	0.0024	0.0025	0.0026
6	0.0022	0.0025	0.0026
7	0.002	0.0022	0.0023
8	0.0018	0.0019	0.002
9	0.0016	0.0017	0.0018

10	0.0012	0.0014	0.0015
11	0.0011	0.0011	0.0011
12	0.0008	0.0009	0.0009
13	0.0006	0.0006	0.0007
14	0.0005	0.0006	0.0006
15	0.0005	0.0005	0.0005
16	0.0004	0.0004	0.0004
17	0.0002	0.0002	0.0003
18	0.0001	0.0002	0.0002
19	0.0001	0.0001	0.0001
20	0	0	0



4. CONCLUSION AND FUTURE SCOPE

The simulation of wireless communication system with the multiple input single output (MISO) with Alamouti Space Time Block Codes (STBC) and signal modulated with 16-QAM, 32-QAM and 64-QAM techniques. For enhancement of performance of the system FIR filter is applied. In this paper 2nd order and 4th order FIR filter is applied and the BER for 4th order FIR filter is about 10-4 and BER for second order FIR filter is less than 10-3 therefore it can analyzed the results of 4th order FIR filter has given better performance than 2nd order Filter.

If the system is implemented with different modulation technique, and the Alamouti STBC with some encoding technique the system will behave more appropriate. Even if the current filtering technique is replaced with another complex but efficient filter then system will perform better.

5. REFERENCES

[1] K.Sundaravadivu, S.Bharathi.,M.E, 2013,"STBC Codes for Generalized Spatial Modulation in MIMO Systems"2013 IEEE International Conference on Emerging Trends in Computing, Communication and Nanotechnology.

[2] Oussama B. Belkacem, Mohamed L. Ammari, Rafik Zayani And Ridha Bouallegue, 2013, "Capacity Analysis of MIMO-STBC System in the Presence of Nonlinear Distortion and Neural Network Compensator", The Tenth International Symposium on Wireless Communication Systems.

[3] Parismita Gogoi, Kandarpa kumar Sharma,2012, "Pilot Assisted Channel Estimation Technique for Alamouti STBC- MISO and MIMO Set-up with BPSK and QPSK modulation",IEEE.

[4] Feng Hu, Libiao Jin, Jianzeng Li, and Jingwen Ji,2012 "Novel Constructions of MIMO STBC Designs Employing Four Transmit Antennas",International Conference on Industrial Control and Electronics Engineering.

[5] Gogoi, P.; Sarma, K.K., 2012,"STBC coded MISO and MIMO set up in frequency selective wireless fading channels for BPSK and QPSK modulation schemes," Computational Intelligence and Signal Processing (CISP).

[6] Nguyen Trung Hieu, Nguyen Thanh Tu, Nguyen Viet Ha, Tran Thi Thao Nguyen, and Bui Huu Phu,2012 "FPGA Implementation of MIMO-OFDM STBC Systems" International Conference on Control, Automation and Information Sciences , IEEE.

[7] Haixia Zhang, Dongfeng Yuan, and Hsiao-Hwa Chen, 2010,"On Array- Processing-Based Quasi-Orthogonal Space–Time Block-Coded OFDM Systems," IEEE Transactions on Vehicular Technology.

[8] Kai-Ting Shr, Hong-Du Chen, and Yuan-Hao Huang, 2010, "A Low- Complexity Viterbi Decoder for Space-Time Trellis Codes, IEEE Transactions On Circuits And Systems.

[9] Mohammad K. Jubran, Manu Bansal, Lisimachos P. Kondi,, and Rohan Grover, 2009, "Accurate Distortion Estimation and Optimal Bandwidth Allocation for Scalable H.264 Video Transmission Over MIMO Systems," IEEE Transactions On Image Processing.

[10] T. M. Duman and Ali Ghrayeb,2007, "Coding for MIMO Communication System," John Wiley and sons.

[11] Shannon CE.,1948, A mathematical theory of communications. The Bell System Technical Journal.

[12] T. S. Rappaport: "Wireless Communications - Principles and Practice," Pearson Education, 1997.

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