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Performance analysis of MIMO OFDM for QAM by using VBLAST MMSE technique

M. Jyothsna, Assistant Professor, ETE Dept., G. Narayanamma Institute of technology and Science for Women, INDIA

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Abstract:
This Paper indicates the presentation exam of MIMO-OFDM (certainly one of a kind facts numerous yield with symmetrical recurrence department multiplexing) framework utilizing leveling approach minimum mean rectangular blunders. A recognition plan, as an example, V-BLAST calculation is applied over MMSE so you can reduce the innovative obstruction, with the quit purpose that BER execution is advanced. The presentation research of a 4x4 MIMO-OFDM framework by way of the usage of V-BLAST MMSE for QAM regulation strategy is classed w.R.T BER versus SNR. The replica outcomes show that the presentation of V-BLAST MMSE method is advanced to the customary technique MMSE.

***Keywords:** MMSE.,V-BLAST,MIMO-OFDM.*

I. INTRODUCTION

In the recent years wireless networks and mobile communications have grown massively and achieved huge business success. When a signal is transmitted in a wireless networks due to obstacles between transmitter and receiver the signal will undergo several multipath effects. It is well known fact that the wireless multipath channel causes attenuation, phase shift and time dispersion in the received signal. This effect is called fading. Fading is caused due to interference between transmitted signals coming from multiple paths. There are several diversity techniques to handle attenuation issue, interference issue such as MIMO, OFDM, Rake receiver etc.

In the recent times MIMO OFDM system, i.e. OFDM with a MIMO transceiver system garnered a lot of interest because as the name indicates multiple outputs at receiver and multiple inputs at transmitter is much better and advantageous when compared to a single transceiver (SISO-Single input Single output) system and it increases diversity gain and the capacity of the system. The two main goals of MIMO wireless system are high data rate and high performance. The combined MIMO-OFDM system is advantageous because OFDM is able to sustain more number of antennas and it simplifies equalization in MIMO systems.

II.V-BLAST BASED SYSTEM MODEL

A V-BLAST [1] transmission system is shown in figure1. The incoming bits are given to demulitplexer and then modulated with QAM. The modulated signal is given to IFFT block and cyclic prefix is added to the output of IFFT block and the signal is transmitted through the wireless channel[3].

At the receiver end, cyclic prefix is removed and the FFT is applied on the resultant signal and passed through a V-BLAST detector. The received signal at first antenna can be represented as,

$$y_1 = [h_{1,1} h_{1,2}] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + n_1$$

and the received signal at the second receive antenna can be represented as,

$$y_2 = [h_{2,1} h_{2,2}] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + n_2$$

So, in general the received signal can be represented as,

$$y = Hx + n$$

Where x stands for the transmitted signal and n stands for the additive white Gaussian noise (AWGN) which added to the signal.

The MIMO channel is converted into a set of N parallel narrow band channels and then the V-BLAST algorithm is applied to this N parallel channels on per subcarrier basis.

The input data is separated into substreams. The QAM symbols of a certain substream are transmitted through the same antenna.

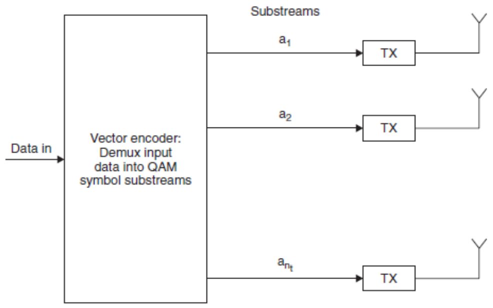

Fig1: Block diagram of V-BLAST transmission system.

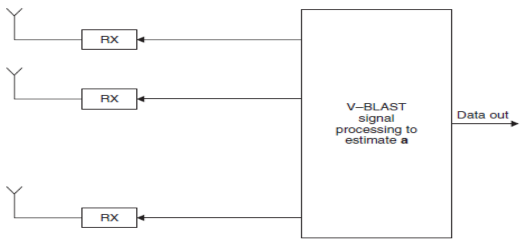

Fig2:V-BLAST receive system

The QAM transmitters [10] work in co-channels at equivalent photograph fee with synchronized photo timing. VBLAST utilizes Successive Interference crossing out in which impact of each assessed photograph is dropped from the got picture. In the accompanying examination, the place is finished along the vertical arrangement of the got substreams that arere-requested through the degree in their SNRs.

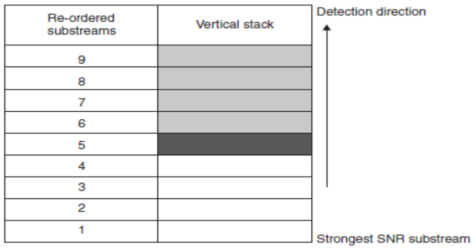

Figure 3:Estimation of the substream with the strongest SNR

As seemed in the parent 3, the most grounded SNR substream is assessed by means of the finder and in a while it's far subtracted from the had been given vector. From that aspect forward, the following substream with the subsequent maximum noteworthy SNR is evaluated and subtracted, and many others.

At the point while we bear in mind evaluating photographs from substream five, we ought to have as of now successfully

Assessed substreams 1 to four with the goal that we can drop their obstruction from the had been given vector. Be that as it can, substreams 6 to 9 need to be nulled the use of both a base imply squared blunder or 0-using popular. The were given discrete–time complicated baseband signal vector r is given with the resource of fig2 in which the channel bypass paintings is spoken to thru the nr×nt complicated framework H and the complex components hki are portraying the exchange art work from the ith transmitter to the kth beneficiary. The V-BLAST calculation works on the were given vector r to join up the choice measurements yj[1].

The algorithm [10], described as follows sets the initialization values for the first iteration (j=1):

$$r_1 = r$$

$$H_1 = H$$

For the jth iteration, we run through the following procedure:**Step 1:** compute the inverse of H_j. Compute the Moore-Penrose pseudo inverse matrix H_j^+.We set the nulling vector q_j equal to the jth column of the Moore-Penrose pseudo inverse matrix: $(H^+_j)_j$:$q_j = (H^+_j)_j$The decision statistics

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variable y_j is given by:$y_j = q^T_j\ r_j$The decision statistics variable y_j is given by:$y_j = q^T_j r_j$**Step 2:** We estimate the symbol using the information in y_j:$\breve{a}_j$= Q(y_j)where Q(.) denotes quantization or any other appropriate slicing process.**Step 3:** Assuming that the estimation of $a_j$is correct now, cancel the interference due to the k^{th} symbol from received signal $\mathbf{r}_j$ to obtain a modified received signal r_{j+1}:$r_{j+1}= r_j - \breve{a}_j\ (H_j)_j$ where $(H_j)_j$ is the jth column of the matrix H_j.**Step 4:** Zero the kth column of the matrix H_j to obtain $H_{j+1}$and we set k to j+1 and repeat steps 1–4 until all the substreams are detected.

III Minimum Mean Square Error

MMSE [1] is one of the linear detection techniques. The filter matrix for MMSE is

$$\boldsymbol{G} = \left(\boldsymbol{H}^H \boldsymbol{H} + \frac{N_t}{SNR} \boldsymbol{I}_{N_r} \right)^{-1} \boldsymbol{H}^H$$

Now V-BLAST algorithm can be applied over above filter matrix. The below simulation result shows the performance comparison of MMSE detector and MMSE-V-BLAST detector in terms of BER/SNR.

IV. SIMULATION RESULTS

The simulation results shows that a 4X4 MIMO-OFDM system for QAM Modulation Technique by using V-BLAST MMSE shows better BER performance compared to MIMO-OFDM system with MMSE.

Simulation Parameters:

Parameter	Specifications
Modulation	QAM
Channel	Rayleigh
No. Of transmitters, No. of receivers	4,4
FFT length	16

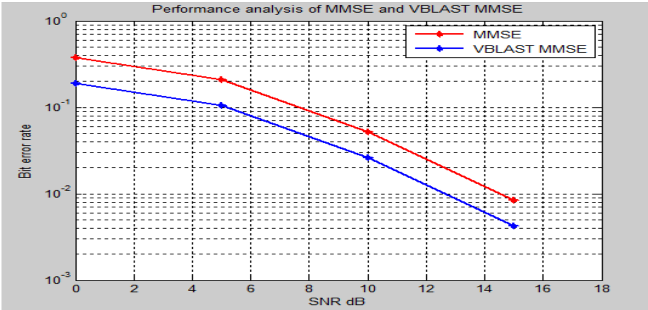

Figure 4:Performance analysis of MIMO OFDM for QAM by using MMSE and VBLAST MMSE technique

SNR(dB)	Bit error rate(BER) for MMSE	Bit error rate(BER) for V-BLAST MMSE
0dB	0.373	0.172
5dB	0.210	0.091
10dB	0.060	0.029
15dB	0.008	0.036
20dB	0.003	0.0015

V.CONCLUSION

The performance of V-BLAST MMSE and MMSE by using Quadrature Amplitude Modulation and their comparison on the basis of BER/SNR is analyzed and hence better performance is obtained for VBLAST MMSE without additional complexity.

For high data rate applications, when the number of transmitting and receiving antennas are increased and for higher modulation schemes we can prefer VBLAST mmse as a decoding technique where the complexity is reduced.

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