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Performance Analysis with Space-time coding in MIMO-OFDM Systems with Multiple Antennas

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Abstract

In this paper we show the performance analysis from the previous research and find the drawbacks for the further enhancement. We are considering the case of multiple antennas so that we achieve the higher space-time coding diversity gain and the better performance of system.

Keywords

Diversity Gain, Space Time Coding, MIMO, OFDM

1. Introduction

In [1] the primary disadvantage to using MIMO techniques is that multiple antennas and multiple RF transceiver chains are necessary to convert the signals between baseband and the RF channel. Commonly, these multiple transceivers are implemented within the same radio device, making the equipment more complex and difficult to field at lower RF operating frequencies[1].Multiple-input multiple-output (MIMO) systems combined with orthogonal space time block codes (OSTBCs) and orthogonal frequency division multiplexing (OFDM), known as MIMO-OFDM, are playing an important role in current and future wireless communications[2].

Space-time coding introduces redundancy in space, though the addition of multiple antennas, and redundancy in time, through channel coding. Two prevailing space-time coding techniques are Space Time Block Codes (STBC) and Space Time Trellis Codes (STTC). STBC provide diversity gain, with very low decoding complexity, whereas STTC provide both diversity and coding gain at the cost of higher decoding complexity. STBC must be concatenated with an outer code to provide coding gain. Concatenating STBC with Trellis Coded Modulation (TCM) creates a bandwidth efficient system with coding gain.

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The performance of the concatenated systems is examined under the quasi-static and block fading channel conditions. Additionally, the performance of the concatenated system is evaluated for three different mapping techniques. Finally, STTC are compared against the concatenated STBC-TCM scheme for the quasi-static and block fading channel.

We provide here an overview of MIMO OFDM System. Other sections are arranged in the following manner: Section 2 introduces Space Time Trellis Coding; Section 3 describes about Related Work; Section 4 shows the analysis; Section 5 describes Conclusion.

2. Space Time Trellis Coding

Space Time Trellis Coding (STTC) is a MIMO technique that provides full diversity and coding gain. STTC combines coding, modulation, transmit diversity, and optional receive diversity. The coding gain is obtained at the cost of increased decoding complexity. Originally proposed for two transmit antennas, STTC has since been extended to more transmit antennas. Figure 1 shows a block diagram of a STTC, with Nt transmit antennas and Nr receive antennas. First, the channel code encodes the source data. The space-time trellis encoder maps one symbol at a time, to an Nt x 1 vector output. The channel code creates correlation between code words across time (between successive symbols) and space (between different transmit antennas).

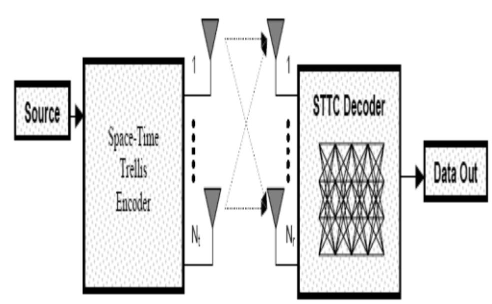

Figure 1: Block Diagram of STTC

3. Related Work

In 2010, Mohammad Torabi et al. [3] investigate the combination of different techniques, resulting in user scheduling schemes for multiuser MIMO-OFDM systems employing orthogonal space–frequency block coding (OSFBC) over multipath frequency selective fading channels. Our contribution is a performance analysis framework that evaluates the advantages of employing user scheduling in MIMO-OFDM systems employing OSFBC in conjunction with adaptive modulation schemes. They derive analytical expressions for the average spectral efficiency (ASE), the average bit error rate (BER), the outage probability, and the average channel capacity for different scheduling and adaptive modulation schemes. Discrete-rate and continuous rate adaptive modulation schemes are employed to increase the spectral efficiency of the system. They assume a signal to-noise-ratio (SNR)-based user-selection scheme and the well known proportional fair scheduling (PFS) scheme.

In 2011,Ashutosh Dubey et al. [4] proposed a Modernize SLM (MSLM) scheme to reduce the PAPR by using the complex signal separate into real & imaginary parts and individually phase sequence multiple real as well as imaginary part of complex signal then select minimum PAPR signal of real & imaginary and these are combine. The simulation show achieves good PAPR, which is a strong candidate for Future wireless communication.

In 2011, Zhang jie et al. [5] presents a simulation model of MIMO-OFDM system based on STBC which built and transmission performances under different channels are analyzed. The simulation results show that the MIMO-OFDM system based on STBC outperforms other MIMO-OFDM system without STBC in BER performance.

In 2011, Aaditya Khare et al. [6] propose a novel approach which is reduce PAPR and Computational complexity without any distortion based on clipped OFDM. In these technique the phase sequence multiplication before perform FFT operation by using PN sequence generator and second phase sequence multiplication is the invert version of PN sequence generator. The performance of Space-Frequency (SF) block coding for MIMO OFDM along with different equalizers is also analysed. Bit Error Rate (BER) analysis is presented using different equalizers and then optimum equalization method is suggested. They show the practical aspect of propose scheme in MATLAB environment.

In 2012, Shruti Trivedi et al. [7] discusses about Multiple transmit and receive which can be used to form multiple input multiple-output (MIMO) channels to increase the capacity and data rate. The key advantage of employing multiple antennas is to get reliable performance through diversity and the achievable higher data rate through spatial multiplexing. In MIMO system some information can transmitted and received from multiple antennas simultaneously since the fading for each link between a pair of transmit and receive antennas can usually be considered to be independent, the probability that the information is detected accurately is higher. Fading of the signal can be mitigated by different diversity techniques, where the signal is transmitted through multiple independent fading paths in terms of the time, frequency or space and combined constructively at the receiver. They analyse Bit Error Rate (BER) using BPSK modulation and then optimum modulation is analysed.

In 2012, P. Samundiswary et al. [8] proposed MIMO-OFDM system using Vertical Bell Lab layered S pace Time (V-BLAS T) which is developed by considering Minimum Mean Square Error(MMSE) and Zero Forcing (ZF) detector mechanisms for various modulation schemes and antenna. The performance parameter of MIMO-OFDM in terms of BER is determined and analysed for two different detector schemes such as MMSE and ZF with the help of MAT LAB package.

In 2012, P . Mukunthan et al. [9] presented PAPR reduction based on a modified PIS scheme combined with interleaving and pulse shaping method in MIMO-OFDM. They analyses the influence of the number of the detected peaks on PAPR reduction performance and on complexity, and then obtain the optimal parameter to achieve better PAPR reduction performance and lower complexity. Their simulation results have shown that modified P1S with interleaving and the pulse shaping method can improve PAPR performance in the MIMO-OFDM.

4. Analysis of Related Research Results

In [5] author considers the following parameters as shown in table 1.

Table 1: Simulation Parameter [5]

Parameter	
Channel Model	Rayleigh/ AWGN
Channel Bandwidth	4M
R V parameters	[0 I 2 3]
HARQ combining	Incremental redundancy
Frame structure	TDD
modulation	16QAM
Diversity scheme	2 or 4 Tx ,lor 2 Rx antennas
separation distance	4 λ
antennas Transmitting Power	equality

In [5] author suggests that STBC has a better transmission performance than the uncoded ones.
In [8] author considers the following parameters as shown in table 2.

Table 2: Simulation Parameter [8]

Parameter	
Simulation Parameters	Range/Value
Modulation schemes	256QAM,64-PSK
FFT Size	64
SNR(dB)	O to 70
Channels	Rayleigh fading channel
Receiver detection schemes	MMSE and ZF

In [8] author observed through simulation result that 2x5 antenna configuration of MMSE detection schemes achieves BER of 10^{-3} at less SNR value of 32 dB than that of 2x3 antenna configuration which achieves the same BER value at SN R of 36 dB. The improvement in the BER performance of2x5 antenna configuration is due to the increase in the number of receiver antennas and high level modulation schemes. In [8] they also observed that the simulation results for 2x5 antenna configuration of ZF detection schemes out performs 2x3 antenna configuration by achieving BER of 10^{-2} at SNR value 32dB. The high order (2x5) antenna configuration improves the BER performance of MIMO-OFDM using ZF detection scheme.

In [9] author considers the following parameters as shown in table 3.

Table 3: Simulation Parameter [9]

Parameter	
Simulation parameters	Type/Values
Number of sub carriers (N)	64,128, 256,512,1024
Number of sub blocks (V)	2,4,8,1 6
Overs amp ling factor (L)	4
Ro1 1-0 ff factor (a)	0. 6
Subblock partitioning scheme	Interleaving
Number of antennas	2
Modulation scheme	QPSK
Phase weighting factor (b)	1,-1,j,-j

In [9] author shows the performance of the modified PTS technique with interleaving and pulse shaping method in MIMO-OFDM system for different number of subcarriers N= 64, 128, 256, 512, and 1024. They observed that the values of PAPR for N= 64, 128,256, 512, and 1024 become 6 . 9dB, 7. 6dB, 8. 2dB , 8. 6dB and 9dB respectively when CCDF = 10'2. The PAPR value increases significantly as number of subcarriers used in the MIMO-OFDM transmission increase. This improvement in PAPR is valid for any number of subcarriers of the OFDM signal by using pulse shaping technique [9].

In [10] assume that perfect channel state information (CSI) is available at the receiver. At the receiver, a maximum likelihood sequence detector is used to decode the received signal. Then a modified vector Viterbi decoder is employed. Error probability calculation is carried out after decoding each frame. They increase the receiver antennas we get more coding gain. It increases 4to32states.we find higher coding gain at 2 receiver antennas at 32 states. They also get less S\N ratio.

5. Conclusion

In this paper we discuss several aspects in the direction of Space-time coding in MIMO-OFDM Systems with Multiple Antennas. We also discuss the previous results in the direction of our survey and we find that increasing the number of antenna has better transmission performance. We also observe that increasing the states also reduces the signal to noise ratio.

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