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Extensive Survey on Space Time Codes over Fading Environment

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Abstract:* Now-a-days a speedy and more reliable communication links along with Multiple-input multiple-output (MIMO) arrangements has become a prime concern in the field of Communication systems. Smart antenna wireless communication systems provide significant gains in terms of spectral efficiency and link reliability. These benefits translate to wireless networks in the form of improved coverage and capacity. MIMO communication theory is an emerging area and full of challenging problems. Some promising research areas in the field of MIMO technology include channel estimation, n As MIMO arrangement resort to several number of antennas first at the transmitter and second at the receiver, the indispensable need to slash the fading resulting from signal inconstancy in the channel is Dissimilarity. In this effort the investigation of MIMO systems using STBC codes and OSTBC cryptograph and systematic the BER vs. Eb/N0 attitudes have been drifting out. The attainment investigation of space–time block-coded (STBC-MIMO) arrangement in disparate paling way such as Rayleigh way and Additive White Gaussian way (AWGN) way is granted in this argumentation. By comparability investigation of moderate bit error rate (BER) of STBC-MIMO for binary phase-shift keying (BPSK), quadrature phase shift keying (QPSK) and Quadrature amplitude modulation (QAM) – both 8-QAM and 16-QAM are derived.

I. INTRODUCTION

Wireless designers constantly seek to improve the spectrum efficiency/capacity, coverage of wireless networks, and link reliability. Space-time wireless technology that uses multiple antennas along with appropriate signalling and receiver techniques offers a powerful tool for improving wireless performance[1].

Multiple antennas when used with appropriate space-time coding (STC) techniques can achieve huge performance gains in multipath fading wireless links. The fundamentals of space-time coding were established in the context of space-time Trellis coding by Tarokh, Seshadri and Calderbank. Alamouti then proposed a simple transmit diversity coding scheme and based on this scheme, general space-time block codes were further introduced by Tarokh, Jafarkhani. Since then space-time coding has soon evolved into a most vibrant research area in wireless communications[2]. Recently, space-time block coding has been adopted in the third generation mobile communication standard which aims to deliver true multimedia capability. Space-time block codes have a most attractive feature of the linear decoding/detection algorithms and thus become the most popular among different STC techniques[3]. The decoding of space-time block codes, however, requires knowledge of channels at the receiver and in most publications, channel parameters are assumed known, which is not practical due to the changing channel conditions in real communication systems[4].

This paper is mainly concerned with orthogonal space-time block codes and their performances. The focus is on Bit error rate and channel estimation for wireless communication systems using orthogonal space-time block code and Quasi Orthogonal space time block code[5]. We first present the required background materials, discuss different implementations of space-time block codes using different numbers of transmit and receive antennas, and evaluate the performances of space-time block codes using binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK), and quadrature amplitude modulation (QAM). Then, we investigate Orthogonal Space time block with Different channel like AWGN Channel, Rayleigh Fading Channel .and compare the bit error rate performance and maximum diversity gain.

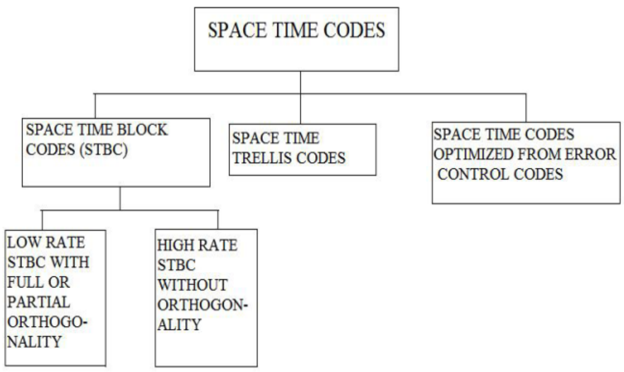

Fig 1.1 Classification of space-time codes[1]

Communication technologies have become a very important part of human life. Wireless communication systems have opened new dimensions in communications. People can be reached at any time and at any place[6]. Over 700 million people around the world subscribe to existing second and third generation cellular systems supporting data rates of 9.6 kbps to 2 Mbps. More recently, IEEE 802.11 wireless LAN networks enable communication at rates of around 54Mbps and have attracted more than 1.6 billion USD in equipment sales. Over the next ten years, the capabilities of these technologies are expected to move towards the 100 Mbps - 1 Gbps range and to subscriber numbers of over two billion[7].

- *Space-time trellis codes:*For a given number of transmit antennas, the code design objective is to construct the largest possible codebook with full diversity gain and the maximum possible coding gain. A number of hand-crafted STTCs (space-time trellis codes) with full diversity gain. Full diversity codes with greater coding gain were then reported where codes were found through exhaustive computersearches over a feedforward convolutional coding (FFC) generator. New codes were then presented by searching for the codes with the best distance spectrum properties. The distance spectrum of a codebook counts how many pairs of codewords are located at a given product distance
- *Linear space-time block codes:*Since linear codes are easier to encode and decode, we will focus on the design of linear codes here. A linear code is defined as a set of codewords that are linear in the scalar input symbols.

1.1 Introduction to the Wireless Problem

Due to an explosion of demand for high-speed wireless services, such as wireless Internet, email, stock quotes, and cellular video conferencing, wireless communications has become one of the most exciting fields in modern engineering. However, development of such products and services poses a serious challenge: how can we support the exceedingly high data rates and capacity required for these applications with the severely restricted resources offered in a wireless channel?

The obstacles associated with wireless environments are difficult to overcome. Interference from other users and inter-symbol interference (ISI) from multiple paths of one's own signal are serious forms of distortion [1], the latter effectively causing frequency-selective channel properties. Furthermore, when transmit and receive antennas are in relative motion, the Doppler effect will spread the frequency spectrum of received signals [2]. 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, the usual additive white Gaussian noise (AWGN) corrupts the signal.

Besides the above difficulties, there are extremely limited bandwidth and stringent power limitations on both the mobile unit (for battery conservation) and the base station (to satisfy government safety regulations). To conserve bandwidth resources, we maximize spectral efficiency by packing as much information as possible into a given bandwidth. A solution to the bandwidth and power problem is the 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. We must look to other means, such as space-time coding, to increase data rate, capacity, and spectral efficiency.

1.2 Space-Time Coding

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. Bits entering the 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 the antenna corresponding to that sub-stream. The scheme used to map bits to signals is the called a space-time code. Signals transmitted simultaneously over each antenna interfere with each other as they propagate through the wireless channel. Meanwhile, the fading channel also distorts the signal waveforms. At the receiver, the distorted and superimposed waveforms detected by each receive antenna are used to estimate the original data bits

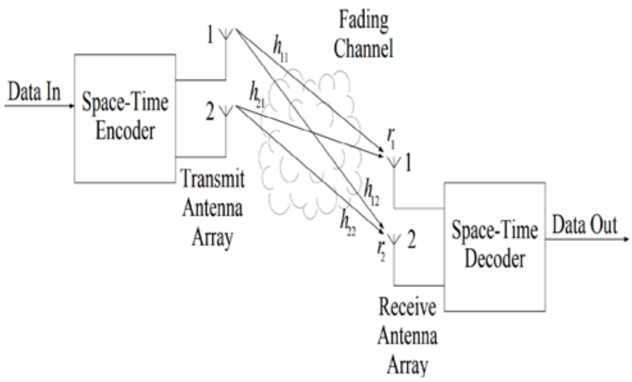

Fig. 1. A typical communication system utilizing space-time coding.

1. Notation

The following notation is used throughout this thesis.

- $j = \sqrt{-1}$.
- $x^*$is the complex conjugate of x.
- $\Re$ (x) is the real part of x.
- $\angle x$ is the phase of x.
- E [X] is the expected value of random variable X.
- $X^T$is the transpose of matrix X.

• X^H is the conjugate transpose of matrix X.

• I_n is the $n \times n$ identity matrix.

• 0_n is the $n \times n$ zero matrix.

1.3 Channel Model

In a space-time system, define N_t to be the number transmit antennas and N_r the number of receive antennas. Furthermore, assume we use a block coded system in which L2 ^{M} bits enter the encoder every block epoch. These bits are mapped to L symbols, each with an M-ary sized constellation, and transmitted over a block of T time intervals. We say this is an (N_t , N_r) block coded system with rate R = L/T. A mathematical model for any space-time block coded system is given by

R=SH+N,…………………… ……………… (1.1)

where

• R is a T × N_r matrix representing the received data.

• S is a T × N_t matrix representing the transmitted symbols.

• H is an N_t × N_r matrix representing quasi-static flat Gaussian fading.

• N is a T × N_r matrix representing AWGN.

1.4 The Code Matrix:

Elements of code matrix S are typically complex baseband symbols from a PSK or QAM constellation. A given column of S represents the stream of data sent by a specific transmit antenna, while a given row represents the information sent in a single time interval. This structure in the code matrix gives the name, "space-time coding." The average energy transmitted in each space-time code block satisfies E [trace (SS^H)] = T N_tE, where E is the average complex baseband symbol energy.

1.5 Benefits of Space-Time Coding:

- *Improved Performance with Diversity:* Space-time coding can improve performance through an effect known as diversity. Diversity is a measure of the average number of channels fully utilized by each piece of information transmitted. The maximum diversity available to a space-time system is NtNr, which is the total number of channels between the transmitter and receiver. When adding new antennas to a system, the receiver can use the extra channels to improve the probability of correctly identifying the true transmitted signal. We may view the new channels as redundancy, or backup in case other channels fail.

- *Higher Data Rate, Capacity, and Spectral Efficiency:* In general, the data rate of a space-time block code is defined to be the average number of symbols sent per time epoch, or simply R = L/T. A space-time code is full rate if L = T. The spectral efficiency of a modulation scheme is given by

  $$\eta = \frac{\text{Data Rate}}{\text{Bandwidth.}}$$

  We define the spectral efficiency of a space-time code using a two-dimensional constellation with M points to be η = R log2 M bits/sec/Hz. Improved performance from diversity may be used to attain higher data rates by increasing the symbol constellation size. Since M-PSK and M-QAM modulations are bandwidth efficient signaling schemes (they use a fixed amount of bandwidth for any M), space-time coding enables us to achieve higher levels of spectral efficiency at a fixed bandwidth and error rate.

- *Simpler Handheld Design:* We can achieve the same diversity effects with multiple antennas at the transmitter as with multiple antennas at the receiver. Thus, transmit diversity is appealing in systems with multiple information recipients, such as broadcast and cellular schemes. This is because we can increase diversity in all subscriber units by adding just one antenna to the base station, instead of a new antenna to each individual receiving unit, thus reducing the cost and complexity of each handheld device.

1.6 Receiver Design For A General Mimo Channel:

For a general MIMO channel, the receiver receives a superposition of the transmitted signals and must separate the constituent signals based on channel knowledge. The method of spatial deconvolution determines the computational complexity of the receiver. This problem is similar in nature to the multi-user detection problem in CDMA and parallels can be drawn between the receiver architectures in these two areas. The signal design in this chapter assumed maximum likelihood (ML) decoding, which amounts to exhaustive comparisons of the received signal to all possible transmitted signals. This is computationally prohibitive for higher order constellations such as 64-QAM, which for example would require 64^2 =4096 complex multiplications, Euclidean distance computations and comparisons for two transmit antennas. While ML detection is optimal, receiver complexity grows exponentially with the number of transmit antennas making this scheme impractical. Lower complexity sub-optimal receivers include the zero-forcing receiver (ZF) or the minimum meansquare error (MMSE) receiver, the design principles of which are similar to equalization principles for SISO links with inter-symbol interference

(ISI). An attractive alternative to ZF and MMSE receivers is the vertical BLAST (V-BLAST) algorithm which is essentially a successive cancellation technique. An exciting new algorithm that yields ML-like performance with cubic instead of exponential complexity is the sphere decoding algorithm.

1.7 Modulation And Coding For MIMO

The signal design in this chapter did not include effects of concatenated coding. MIMO technology is compatible with a wide variety of coding and modulation schemes. In general, the best performance in achieved by generalizing standard (scalar) modulation and coding techniques to matrix channels. MIMO has been proposed for single-carrier (SC) modulation, direct-sequence code division multiple access (DS-CDMA) and orthogonal frequency division multiplexing (OFDM) modulation techniques. MIMO has also been considered in conjunction with concatenated coding schemes. Application of turbo codes and low density parity codes to MIMO has recently generated a great deal of interest, as have simpler coding and interleaving techniques such as bit-interleaved coded modulation (BICM) along with iterative decoding. Inclusion of concatenated codes along with soft Viterbi decoding is in fact essential for realizing the full diversity gain of practical MIMO systems.

1.8 Advantages of MIOM

- Can achieve full diversity with linear processing at the receiver.
- Open loop transmit diversity technique
- Simple encoding and decoding
- No bandwidth expansion

II. LITERATURE SURVEY

“Performance Analysis of Space–Time Block-Coded MIMO Systems With Imperfect Channel Information Over Rician Fading Channels” By Xiang-Bin Yu, Shu-Hung Leung, and Xiao-Min Chen. IEEE Transactions On Vehicular Technologgy, Vol. 60, No. 9, November 2011. The performance analysis of space–time block-coded multiple-input–multiple output (STBCMIMO) systems in Rician fading channels for perfect and imperfect channel state information (CSI) is presented in this paper. Accurate expressions of average bit error rate (BER) and symbol error rate (SER) of STBC-MIMO for multiple phase-shift keying (MPSK) and quadrature amplitude modulation (QAM) are derived. Based on asymptotic analysis and Nakagami

approximation for Rician fading, closed-form expressions of approximate average BER and SER are obtained for low and high signal-to-noise ratios (SNRs). By combining the error rate expressions of low SNR and SNRs, approximate BER and SER expressions can be obtained for different SNRs. Computer simulation shows that the theoretical analysis is in good agreement with the simulation results, and the approximate expressions derived from the integration of high and low SNR asymptotic analyses are close to the accurate formulas for different SNRs. The asymptotic analysis at high SNR indicates that the coding gain is affected by the Rice factor, transmit and receive antenna numbers, code rate, and modulation, whereas the diversity gain is

governed by the transmit and receive antenna numbers. However, the diversity gain will be zero at high SNR in the presence of estimation errors because of the error floor in the error probability curves.

“A Simple Space-Time-Frequency Block Code Scheme for Four Transmit Antennas” By Wei Song · S. P. Balakannan · Moon Ho Lee. Springer Science+Business Media, LLC. 2012. It is well known that the full rate and full diversity complex space-time block code (STBC) is not existed for four transmit antennas. In this letter, we propose a simple quasi-orthogonal spacetime-frequency block code (QO-STFBC) scheme with four transmit antennas and n_R receiveantennas, where every two transmit antennas constitute one group and each group transmits signals over different subcarriers. The receiver can separate the received signals from each group via odd/even index FFT operation. After recombining the separated received signals with received antennas, an equivalent half rate orthogonal STFBC (O-STFBC) can be used for decoding. Thus, the full rate and full diversity are achieved at the transmitter and receiver, respectively. Simulation result shows that the proposed QO-STFBC scheme has better performance than the other schemes, in rate 2 layered Alamouti scheme is about 4 dB, full rate QO-STBC scheme is about 5 dB and half rate O-STBC scheme is about 7 dB at 10^{-3} BER for the transmission of 2 bits/s/Hz.

“Randomized Isometric Linear-Dispersion Space-Time Block Coding for the DF Relay Channel” By David Gregoratti, Member, IEEE, Walid Hachem, Member, IEEE, and Xavier Mestre, Senior Member, IEEE. IEEE Transactions On Signal Processing, Vol. 60, No. 1, January 2012. This paper presents a randomized linear-dispersion space-time block code for decode-and forward synchronous relays. The coding matrices are obtained as a set of columns (or rows) of randomly generated Haar-distributed unitary matrices. With respect to independent and identically distributed (i.i.d.)-generated codes, this particular isometric structure reduces the intersymbol interference generated within each relay. The gain over i.i.d. codes in terms of spectral efficiency is analyzed for both the LMMSE and the ML receivers under the assumption of frequency-flat quasistatic fading. In this setting, the spectral efficiency is a random quantity, since it depends on the random coding matrices. However, it is proven that the spectral efficiency converges in probability to a deterministic quantity when the dimensions of the matrices tend to infinity while keeping constant their ratio, i.e., the coding rate . Consequently, when the random coding matrices are large enough, the presented system behaves as a deterministic one. This result is achieved by means of the rectangular R-transform, a powerful tool of free probability theory which allows determining the distribution of the singular values of a sum of rectangular matrices.

"3-Time-Slot Group-Decodable STBC with Full Rate and Full Diversity" By Tian Peng Ren, Chau Yuen, Yong Liang Guan, and Kun Hua Wang. IEEE Communications Letters, Vol. 16, No. 1, January 2012. In this paper, authors propose a generic method to construct group-decodable space-time block

codes (STBC) with arbitrary code dimensions, including odd time slot. Based on the proposed code construction method, 3-time-slot STBC for two transmit antennas with full or even higher code rate can be obtained. The full-rate 3-time-slot STBC obtained can achieve full diversity and symbol-wise decoding complexity. It serves as a solution to the orphan-symbol (3-time-slot) transmit diversity issue raised in 3rd Generation Partnership Project (3GPP) standards.

"Analysis of Indoor Multiple-Input Multiple-Output Coherent Optical Wireless Systems" By Georgia Ntogari, Thomas Kamalakis, and Thomas Sphicopoulos, *Member, IEEE*. Journal Of Light wave Technology, Vol. 30, No. 3, February 1, 2012. Indoor optical wireless systems (OWS) provide an attractive alternative for realizing next generation home access networks. Homodyne detection can be employed in order to enhance receiver sensitivity and spectral efficiency. In this paper, the application of space-time blockcoding (STBC) techniques in a coherent OWS is theoretically and numerically investigated, taking into account the noise characteristics at the receiver. The performance of STBC multipleinput multiple-output (MIMO) systems, employing two transmit elements, is compared against single-input/single-output systems operating with the same total optical transmit power. It is shown that STBC is an effectivemeans to increase the capacity of coherent OWS, improve their coverage, and decrease the required optical power at the transmitter. These results demonstrate the usefulness of MIMO techniques in the realization of future optical wireless local area networks.

"Adaptive Detection for Double STBCs Based on QR Decomposition" By Hung-Ta Pai, Senior Member, IEEE. IEEE Transactions On Vehicular Technology, vol. 61, No. 3, March 2012. This study proposes an efficient detection algorithm for double space-time block codes (DSTBCs) to improve the algorithm of Kim *et al.* The proposed algorithm applies QR decomposition to the channel matrix of the DSTBC to obtain an upper triangular matrix. The diagonal entries of the upper triangular matrix contain two different values. The proposed algorithm adaptively determines the number of candidates for the DSTBC according to the ratio of these two diagonal values. When their ratio is large, the number of the candidates decreases. Finally, the detection result is searched among the candidates based on a maximum-likelihood criterion. Numerical results demonstrate that the computational complexity for the search process can be reduced by 70% with little performance loss at a bit error rate (BER) of 10^{-4}.

"Application of Perfect Space Time Codes: PEP Bounds and Some Practical Insights" By Lina Mroueh, St´ephanie Rouquette-L´eveil, and Jean-Claude Belfiore. IEEE Transactions On Communications, Vol. 60, No. 3, March 2012. The design of perfect space time codes constructed from cyclic division algebra (CDA) on the quasi-static MIMO channel has received lots of attention in industry over the last few years. However, the recent standards that use multiple antennas terminals such as IEEE 802.11n, IEEE 802.16e or LTE are based on more realistic assumptions involving the use of outer codes and multi-taps channels. In this paper, the question regarding the utility of using a high dimensional modulation schemes such as space time codes in a standard context is addressed. For this, we

evaluate the performance of the perfect space time codes in term of an upper-bound on the pairwise error probability, and we compare it to the one of simple spatial division multiplexing (SDM) schemes. Finally, simulation results considered in the context of IEEE 802.11n show that the 2×2 MIMO perfect code, *i.e.* the golden code performs relatively similarly as the SDM Scheme in the presence of a good outer code.

"Two Designs of Space-Time Block Codes Achieving Full Diversity With Partial Interference Cancellation Group Decoding" By Wei Zhang, *Senior Member, IEEE*, Tianyi Xu, and Xiang- Gen Xia, *Fellow, IEEE*. IEEE Transactions On Information Theory, Vol. 58, No. 2, February 2012.

A partial interference cancellation (PIC) group decoding based space-time block code (STBC) design criterion was recently proposed by Guo and Xia, where the decoding complexity and the code rate traeoff is dealt when the full diversity is achieved. In this paper, two designs of STBC are proposed for any number of transmit antennas that can obtain full diversity when a PIC group decoding (with a particular grouping scheme) is applied at receiver. With the PIC group decoding and an appropriate grouping scheme for the decoding, the proposed STBC are shown to obtain the same diversity gain as the ML decoding, but have a low decoding complexity. The first proposed STBC is designed with multiple diagonal layers and it can obtain the full diversity for two-layer design with the PIC group decoding and the rate is up to 2 symbols per channel use. With PIC-SIC group decoding, the first proposed STBC can obtain full diversity for any number of layers and the rate can be full. The second proposed STBC can obtain full diversity and a rate up to 9/4 with the PIC group decoding. Some code design examples are given and simulation results show that the newly proposed STBC can well address the rate-performance-complexity tradeoff of the MIMO systems.

"Novel Receivers for AF Relaying with Distributed STBC Using Cascaded and Disintegrated Channel Estimation" By Fahd Ahmed Khan, *Student Member, IEEE,* Yunfei Chen, *Senior Member, IEEE,* and Mohamed-Slim Alouini, *Fellow, IEEE.* IEEE Transactions On Wireless Communications, Vol. 11, No. 4, April 2012.New coherent receivers are derived for a pilo tsymbol- aided distributed space-time block-coded system with imperfect channel state information which do not perform channel estimation at the destination by using the received pilot signals directly for decoding. The derived receivers are based on new metrics that use distribution of the channels and the noise to achieve improved symbol-error-rate (SER) performance. The SER performance of the derived receivers is further improved by utilizing the decision history in the receivers. The decision history is also incorporated in the existing Euclidean metric to improve its performance. Simulation results show that, for 16-quadrature-amplitude-modulation in a Rayleigh fading channel, a performance gain of up to 2.5 dB can be achieved for the new receivers compared with the conventional mismatched coherent receiver.

"Generalised Spatial Modulation System with Multiple Active Transmit Antennas and Low Complexity Detection Scheme" By Jintao Wang, *Senior Member, IEEE,* Shuyun Jia, and Jian Song, *Senior Member, IEEE.* IEEE Transactions On Wireless Communications, Vol. 11, No. 4, April 2012. A generalised spatial modulation (SM) scheme with multiple active transmit antennas, named as multiple activespatial modulation (MA-SM), is proposed in this paper. By allowing multiple transmitting antennas in the SM system to transmit different symbols at the same time instant, MA-SM takes advantages of the low complexity of SM and high multiplexing gain of Vertical- Bell Lab Layered Space-Time (V-BLAST) system. In the MA-SM system, the transmitted symbols are mapped into a high dimensional constellation space including the spatial dimension. The general principle for designing the efficient MA-SM for arbitrary number of transmit antennas and modulation scheme is presented. Moreover, a near-optimal detection scheme with low complexity for MA-SM is also proposed and analyzed. A closed form bound for the bit error probability (BEP) of the proposed detection scheme is also derived in this paper. Numerical results with the comparison among the existing multiple-input multipleoutput (MIMO) systems such as space time block code (STBC) and V-BLAST demonstrate the efficiency of MA-SM.

"Space-Time Block Coded Spatial Modulation" By Ertu˘grul Ba¸sar, *Student Member, IEEE,* Ümit Aygölü, *Member, IEEE,* Erdal Panayırcı, *Fellow, IEEE,* and H. Vincent Poor, *Fellow, IEEE.* IEEE Transactions On Communications, Vol. 59, No. 3, March 2011. A novel multiple-input multiple-output (MIMO) transmission scheme, called *space-time block coded spatial modulation (STBC-SM),* is proposed. It combines spatial modulation (SM) and

space-time block coding (STBC) to take advantage of the benefits of both while avoiding their drawbacks. In the STBCSM scheme, the transmitted information symbols are expanded not only to the space and time domains but also to the spatial (antenna) domain which corresponds to the on/off status of the transmit antennas available at the space domain, and therefore both core STBC and antenna indices carry information. A general technique is presented for the design of the STBC-SM scheme for any number of transmit antennas. Besides the high spectral efficiency advantage provided by the antenna domain, the proposed scheme is also optimized by deriving its diversity and coding gains to exploit the diversity advantage of STBC. A low-complexity maximum likelihood (ML) decoder is given for the new scheme which profits from the orthogonality of the core STBC. The performance advantages of the STBC-SM over simple SM and over V-BLAST are shown by simulation results for various spectral efficiencies and are supported by the derivation of a closed form expression for the union bound on the bit error probability.

"High-Rate and Full-Diversity Space-Time Block Codes with Low Complexity Partial

Interference Cancellation Group Decoding" By Long Shi, *Student Member, IEEE,* Wei Zhang, *Member, IEEE,* and Xiang-Gen Xia, *Fellow, IEEE.* IEEE Transactions On Communications, Vol. 59, No. 5, May 2011. In this paper, authors propose a systematic design of space-time block codes (STBC) which can achieve high rate and full diversity when the partial interference cancellation (PIC) group decoding is used at receivers. The proposed codes can be applied to any number of transmit antennas and admit a low decoding complexity while achieving full diversity. For transmit antennas, in each codeword real and imaginary parts of complex information symbols are parsed into diagonal layers and then encoded, respectively. With PIC group decoding, it is shown that the decoding complexity can be reduced to a joint decoding of ⁄2 real symbols. In particular, for 4 transmit antennas, the code has real symbol pair wise (i.e., single complex symbol) decoding that achieves full diversity and the code rate is 4⁄3. Simulation results demonstrate that the full diversity is offered by the newly proposed STBC with the PIC group decoding.

III. CONCLUSION

The fact that the paling at two antennas is effectually uncorrupted persuade the diversity reception based on different antennas. In short, multiple observations of transmitted signal can be made from multiple antennas. Each of these observations made is characterized by statistically independent fading channels. accordingly, the probability that all waya pal at the look alike time is much less as to a SISO (Single-input-single-output) system where Signal-to-Noise Ratio would deteriorate. A single time we are established alongside the MIMO (Multiple-input-multiple-output) arrangement, the first and the foremost criterion to be seen is the transmission technique used in this arrangement. Space-time block codes (STBCs) arose from struggle of obtaining highest transmit diversity. Although satrtting benefit of applying STBCs is diversity, it is generaly saw as a general structure of the transmission method hand me down by the way(s) back of the modulation. Space-time coding gives a require full origin of considerate by virtue of what the diversity and multiplexing assistances can be obtained. We first and foremost concentrate on two very highly fundamental ways by title of – Additive white Gaussian noise (AWGN) way and Rayleigh way and some meaning full drawing criteria in order that result in odtaining good attainment in terms of Bit-error rate (BER) or Symbol error rate(SER). new coding and modulation schemes, low complexity receivers, MIMO channel modeling and multiuser SDMA network design.

IV. REFERENCES

[1] www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 9, September 2012)

[2] A. Younis, N. Serafimovski, R. Mesleh, and H. Haas, ―Generalized spatial modulation,‖ in Proc. 2010 Signals, Syst. Comput., pp. 1498– 1502.

[3] D. Gregoratti, W. Hachem, and X. Mestre, "Orthogonal matrix precoding for relay networks," in Proc. IEEE ISWPC 2010,Modena, Ital y, May 5-7, 2010.

[4] E.Biglieri,Y. Hong, and E. Viterbo,―On fast-decodable space-time block codes,‖ IEEE Trans. Inf. Theory, vol. 55, no. 2, pp. 524– 530,Feb. 2009

[5] Lei Guo-Wei, Zhuang Ming-jie "Performance Analysis of Quasi Orthogonal STBC via Antenna Selection" IEEE Trans. Inform. Theory, vol. 45,2008.

[6] "Full-rate full-diversity STBCS for three and four transmit antennas," Electron. Lett.,vol. 44, no. 18, pp.1076–1077, Aug. 2008.

[7] X. Zhang, Z. Lv & W. Wang, "Performance Analysis of Multiuser Diversity in MIMO Systems with Antenna Selection", IEEE Transactions on Wireless Communications, Vol. 7, Issue 1, pp. 15-21,2008.

[8] Claude Oestges and Bruno Clerckx," MIMO Wireless Communication from real world propagation to space-time code design.2007.

[9] Symbol Rate Upper-Bound on Distributed STBC with Channel Phase Information Zhihang Yi, *Student Member, IEEE*, Il-Min Kim, *Senior Member, IEEE*, and Dong In Kim, *Senior Member, vol 12,pp.780-786,2007*

[10] C. Schlegel and Z. Bagley, "MIMO Channels & Space-Time Coding" WOC 2002, Banff, Canada, July 2002

[11] Z. Liu, G. B. Giannakis, S. Zhou, B. Muquet, "Space-time coding for broadband wireless communications", *Wireless Communications and Moblie Computing*, vol. 1, no. 1. pp. 35-53, Jan. 2001.

[12] M. K. Simon and M. S. Alouini, Digital Communication Over Fading Channels: A Unified Approach to Performance Analysis. New York: Wiley, 2000.

[13] V. Tarokh, A. Naguib, N. Seshadri, and A. R. Calderbank, "Combined array processing and space-time coding," IEEE Trans. Inform. Theory, vol. 45. pp. 1121-1128, May 1999.

[14] V. Tarokh,and H. Jafarkhani, "Space-time block Coding for Wireless Communications: Performance Results," IEEE J. Select. Areas Commun., vol. 17,No. 3, March. 1999.

[15] V. Tarokh, H. Jafarkhani, and A. R. Calderbank, "Space-time block codes from orthogonal designs," *IEEE Trans. Inform. Theory*, vol. 45, pp. 1456–1467, July 1999.

[16] S. M. Alamouti, "A simple transmitter diversity scheme for wireless communications," IEEE J. Select. Areas Commun., vol. 16, pp. 1451–1458, Oct. 1998

[17] Hamid Jafarkhani 'Space Time Code , Theory and practise' By Cambridge university press.

[18] I. E. Telatar, "Capacity of multi-antenna Gaussian channels," Eur. Trans. Telecommun., vol. 10, no. 6, pp. 585– 595, Nov. 1999, Invited Paper.