SPACE TIME BLOCK CODED GENERALISED SPATIAL MODULATION UNDER QUASI-STATIC RAYLEIGH FADING CHANNEL

S.Rajalakshmi
Electronics and Communication Engineering
Coimbatore institute of technology

***Abstract*— A New method of MIMO signalling and coding transmission scheme called Space Time Block Coded Generalised Spatial Modulation (STBC-GSM) under spatially correlated Quasi static Rayleigh fading channel condition , with the low complexity maximum likelihood decoder .It is the combination of space time block code with the generalised spatial modulation .The transmitted information symbols in the orthogonal manner are expanded not only to the space and time domain ,but also to the spatial domain .Therefore , Both core STBC and antenna indices carry information .The proposed scheme can provide the diversity and coding gain with reduced transmitters .The performance advantage of STBC-GSM over STBC-SM are to be analysed ,with their bit error probability.**

***Keywords*— STBC ; Spatial Modulation ;Maximum Likelihood Decoding ; MIMO Systems, Generalised Spatial Modulation.**

I. INTRODUCTION

An Increasing demand for the wireless networks has turned spectrum into a precious resource , therefore there is always a method to pack more bits per Hz. Solution for this is case, use of multiple antennas at both transmitter and receiver(MIMO). To combat the multipath fading , resort to diversity coding and achieves high data rate and longer transmission range without requiring additional bandwidth . 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[1].The detailed study of diversity coding for MIMO systems. Different space-time block coding (STBC) schemes including Alamouti's STBC for 2 transmit antennas as well as orthogonal STBC for 3 and 4 transmit antennas are explored[2]. Space Shift Keying of SSK modulation is a novel digital modulation concept suitable for MIMO wireless communication systems. SSK modulation which is a fundamental component of spatial modulation, inherently exploits fading in wireless communication to provide better performance over conventional APM technique [3].The design of high-rate, full-diversity, low maximum likelihood (ML) decoding complexity space-time block codes (STBCs) with code rates of 2 and 1.5 complex symbols per channel use for multiple-input multiple output (MIMO) systems employing three and four transmit antennas[4]. The full-rate, fast-decodable space–time block codes (STBCs) for 2x2 and 4x2 multiple-input multiple- output (MIMO) transmission[5].An increases the capacity and link reliability of the MIMO systems. The BER performance of BPSK, QPSK and QAM in MIMO systems in Rayleigh multipath channel is analysed .V-Blast is used as a detection technique. A comparison of these modulations is also done in Rayleigh fading channel[6]. General method for error analysis of spatial modulation systems over correlated and uncorrelated Rayleigh and Rican channel[7]. Spatial modulation (SM) has emerged as a new and highly effective multiple-input multiple-output (MIMO) communication technology [8]. A general method for the error analysis of spatial modulation (SM) systems over correlated and uncorrelated Rayleigh and Rician fading channels[10].

The main contributions of this paper can be summarized as,

- A new method of MIMO transmission scheme, called STBC-GSM , under quasi static Rayleigh fading channel is proposed, in which information is conveyed with an Orthogonal STBC matrix. The information of STBC is transmitted as a complex matrix .Alamouti code exploits the STBC .The information symbols are considering not only in the two alamouti's STBC ,but also the indices of the two transmitting antennas.
- A general technique is presented for constructing the STBC-GSM under quasi static Rayleigh fading channel scheme for any number of transmit antennas. Since our scheme relies on orthogonal STBC, by considering the general STBC performance criteria diversity and coding gain analyses are performed for the STBC-GSM.

- The Maximum Likelihood decoder is a low complexity decoder ,which derived for the proposed STBC-GSM system, to decide on the transmitted symbols as well as on the indices of the two transmit antennas that are used in the orthogonal STBC transmission .
- The performance of this scheme can be simulated using the matlab communication toolbox .This provides the comparison with STBC-GSM technique , with an optimal decoder under quasi static Rayleigh fading channel, due to its diversity advantage. The average bit error probability are derived for this simulation .The derived upper bound is shown to increasing signal-to-noise ratio(SNR).

  The organization of this paper as follows ,section II contributes system and channel model ,in III OSTBC-GSM model ,optimal ML decoder in IV ,performance analysis in V , results and analysis in VI and conclusion in VII.

II. BACKGROUND

The Traditional wireless systems are affected ,by the multipath propagation .In MIMO system ,however ,this multipath effect is exploited to benefit the user .In fact the separability of parallel streams depend on the presence of rich multipath .

A .Orthogonal STBC-GSM System model

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Fig:1 Block diagram of OSTBC-GSM system model

The block diagram of the OSTBC-GSM system model is shown in fig 1,which describes the combination of OSTBC with the Generalized Spatial Modulation and transmission over multiple transmitter. In this subsection, we generalize the OSTBC-GSM scheme for MIMO systems using orthogonal STBC to N_t transmit and N_r receive antennas by giving a general design technique.At two consecutive symbol interval, $2m$ bits,

$$u = (u_1, u_2 ..., u_{\log_2 c}, u_{\log_2 c+1}, ..., u_{\log_2 c+2\log_2 M})$$

transmitted by the OSTBC-GSM transmitter,

where the first $\log_2 c$ bits determine the antenna-pair position

$$, l = u_1 2^{\log_2 c-1} + u_2 2^{\log_2 c-2} + ... + u_{\log_2 c} 2^0$$

that is associated

The resulting spectral efficiency of the orthogonal STBC-GSM scheme can be calculated as

$$m = 1/2\log_2 c + \log_2 M \quad \text{[bits/s/Hz]}. \tag{1}$$

1.CHANNEL MODEL

Figure 1 depicts such MIMO OSTBC-GSM system model block diagram. It is worth noting that system is described in terms of the channel. For example, the Multiple-Inputs are located at the output of the TX (the input to the channel), and similarly, the Multiple-Outputs are located at the input of the RX (the output of the channel).The channel with Nr outputs and Nt inputs is denoted as a Nr _ Nt matrix:

$$H = \begin{pmatrix} h_{1,1} & h_{1,2} & . & . & h_{1,Nt} \\ h_{2,1} & h_{2,2} & . & . & h_{2,Nt} \\ . & . & . & . & . \\ & & & . & . \\ h_{Nr,1} & h_{Nr,2} & . & . & h_{Nt,Nr} \end{pmatrix} \tag{2}$$

Based on this channel model, the spatially quasi-static Rayleigh fading channel can modeled using the following equation,