Channel Estimation on the bases of Multiuser Space time coding

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Abstract— In wireless transmission the randomness of the communication channel leads to random fluctuation in the received signal. This fluctuation known as fading. The fading is a fundamental problem in wireless communications because of this fading effect we cannot get exact signal at the receiver side. So to improve the signal performance at the receiver side diversity technique is the best method. Diversity defined as the method of conveying information through multiple independent random fades. Diversity gain results multiple paths between base station and user terminal and coding gain results from how symbols are correlated across transmit antennas. Antenna selection reduces the system cost and complexity by reducing the number of radio frequency (RF) chains while still retaining full diversity. Space time coding arises from a technique known as diversity. This technique uses multiple-input and multiple output (MIMO) concepts to overcome the problem of fading and interference in a wireless channel. Wireless communication using multiple-input multiple-output (MIMO) systems enables increased spectral efficiency for a given total transmit power. Increased capacity is achieved by introducing additional spatial channels that are exploited by using space-time coding. The purpose of paper is to development of fundamental space-time (ST) coding and modulation methods to achieve the gains provided by multiple antennas, in terms of both improved robustness of the link and a higher spectral efficiency. Space time codes (STC) provides the details of the encoding and decoding procedures. The codes are designed on an information theoretic criterion. This paper presents the progress made towards determining the capacity and diversity benefits of multiple antennas under different assumptions about the underlying channel. Simulations suggest that the resulting codes allow for effective high-rate data transmissions in multiple-antenna communication systems. Rayleigh channel model and evaluate its performance in term of BER. Finally, the simulation results will be used to analyze and compare their performance. The research will be conducted in MATLAB environment.

Index Terms— Diversity, space-time code, fading channels, wireless communications.

I. INTRODUCTION

Wireless communication systems provide users with wireless multimedia services such as high speed Internet access, wireless television and mobile computing. The rapidly growing demand for these services is driving the communication technology towards higher data rates, higher mobility, and higher carrier frequencies that are needed to enable reliable transmissions over mobile radio channels. The Largest obstacle facing designers of wireless communication systems are the random nature of the wireless propagation Channel [1]. The wireless channel is Non-stationary and noisy due to fading and interference. Recent multiple-input-multiple-output (MIMO) wireless systems can significantly improve the system performance. MIMO technology has thus potential to provide improvements towards wireless communications. However, MIMO systems have increased complexity and cost compared to traditional single-input single-output (SISO) systems. While additional antenna elements (dipole antennas) are inexpensive and give us better performance. MIMO systems with *Nt* transmit and *Nr* receives antennas gives a complete RF chains at the transmitter and the receiver. As we know, STC system also referred to as multiple-input multiple-output (MIMO) system uses at both the transmitter and receiver ends of a wireless communication system to improve communication performance. MIMO wireless technology exploits multipath propagation to improve the quality of service measures such as the bit error rate (BER) or the data rate (bits/sec). In other words, MIMO effectively takes advantage of random fading and multipath delay spread to increase the data transfer rate [2]. The ST code design, a major challenge in MIMO systems, involves finding an optimal way of encoding and transmitting multiple copies of a data stream across multiple antennas to improve the rate and reliability of data transfer. Different smart antenna architectures provide different benefits which can be broadly classified as Array gain, Diversity gain, Multiplexing gain and Interference reduction. The signaling strategy at the transmitter and the corresponding processing at the receiver are designed based on link requirements (data rate, range, reliability etc.). For example, in order to increase the point- to- point spectral efficiency (in bits/sec/Hz) between a transmitter and receiver [3], multiplexing gain is required which is provided by the MIMO architecture. The signaling strategy also depends on the availability of channel information at the transmitter.

II. MULTIPLE ANTENNA COMMUNICATION SYSTEM MODEL

Review In Design the MIMO System, we consider AWGN Rayleigh fading channel models. It is assumed here that the channel undergoes independent fading between the MIMO ends [4].

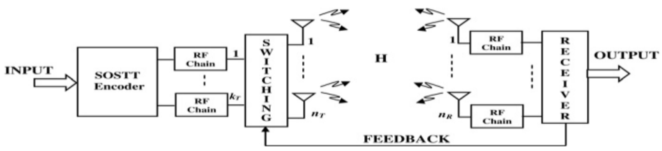

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Fig.II.a MIMO System with TAS (Transmit antenna selection)

The figure shows the block diagram of MIMO system that couples STTC coding with TAS. In figure k_T of n_T transmit antennas are chosen. The receive antennas n_R are used without selection [5]. Let H be n_T x n_R channel matrix. The matrix is represented by h_{ij} (i=1, ….. , n_T and j= 1, ….., n_R) are fading coefficients. The cannel power gain (C_i) between transmit antenna i and all the receive antennas are given by

$$Ci = \sum_{j=1}^{n_R} |hij|^2$$

The Channel power gains are identical and independent distributed.

III. DIVERSITY

As expressed before fading is a fundamental problem in wireless channels. During sometime periods, it is possible that the transmitted symbol can be recovered by receiver in the presence of fading. To remove this dependency is to ensure that individual symbol is sent over several paths undergoes independent fading. The correct transmission of an information symbol is achieved as long as one of its paths is strong [5]. Diversity is a technique through which we can achieve strong paths. Diversity has several types, for space time codes two of them are relevant in our discussion. These are time diversity and space diversity.

Time Diversity

Fading characteristics of wireless communication channel can be viewed as a function of time. Information symbols transmitted with a small time difference will undergo similar amounts of fades. Time diversity is used in digital communication system to combat that the transmissions channel may suffer from error due to time varying channel conditions. The error may be caused by fading. The Time diversity implies that the same data is transmitted multiple times or redundant bits are added for error correction code.

Space Diversity

Antenna diversity, also known as space diversity, is a diversity schemes that uses two or more antennas to improve the quality and reliability of a wireless link. In environments, there is no clear line-of-sight (LOS) between transmitter and receiver. Instead the signal is reflected along multiple paths before finally being received. Each of these bounces can introduce phase shifts, time delays, attenuations, and distortions that can destructively interfere with one another at the aperture of the receiving antenna. Antenna diversity is especially effective for multipath situations [6]. This is because multiple antennas offer a receiver several observations of the same signal. Each antenna will experience a different interference environment. Thus, if one antenna is experiencing a deep fade, it is likely that another has a sufficient signal. However, signal reliability using multiple antennas is an effective way to decrease the number of drop-outs and lost connections.

IV. ANALYSIS OF CHANNEL ESTIMATION ERROR

STBC are very popular technique for MIMO systems, as they enable very simple and linear data encoding and decoding. Space time coding introduces redundancy in space, through the addition of multiple antennas and redundancy in time, through channel coding. Two prevailing STC 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 [7]. STBC must be concatenated with an outer code to provide coding gain. Space Time Block Coding is a low complexity, transmit diversity scheme that yields the same diversity advantage as maximal ratio combining.

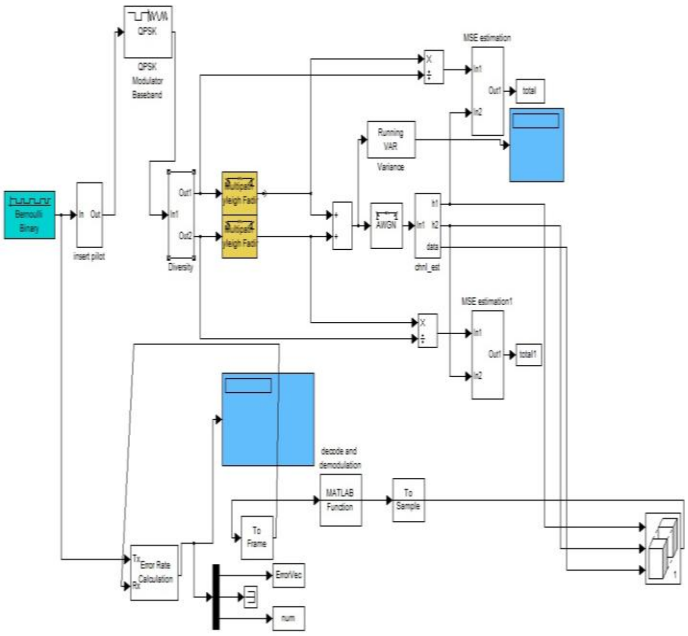

Fig.IV.a Simulink model of MU-STBC system

Suppose there are *M* antennas at the BTS and *Rk* antennas at the *k*th MS. In total, there are *K* users present in the system. The data branch to the *k*th MS is first sent through the space-time encoder $\psi(\cdot)$ to generate the STBC codeword as B*k* = (b*k(1)* ……… b*t*(*T*)). Where b*k*(*t*) is the symbol vector transmitted on time instant t and T is STBC Block length. So by using this model we are evaluating MSE (Mean square error) and evec (error vector).

STBC Concatenated with Trellis Coded Modulation

Space Time Block Coding is a simple technique to achieve diversity; however, there is no significant coding gain. An outer channel code is required to yield coding gain. Trellis Coded Modulation (TCM) is a bandwidth efficient technique that combines coding and modulation, without reducing the data rate. Concatenating STBC with TCM provides coding gain with a reasonable increase in complexity [8]. This estimator provides the channel gains and the phases for each block. So by using STBC technique the bit error rate is being reduced.

V. SIMULATION RESULTS

In this section, we present simulation results to illustrate channel estimation algorithms. The correlated channels are generated by Rayleigh distributed with time autocorrelation function [9]. Here we compare the channel performance by using different numbers of antennas at the transmitting and receiving ends to perform different results as shown in the figure.

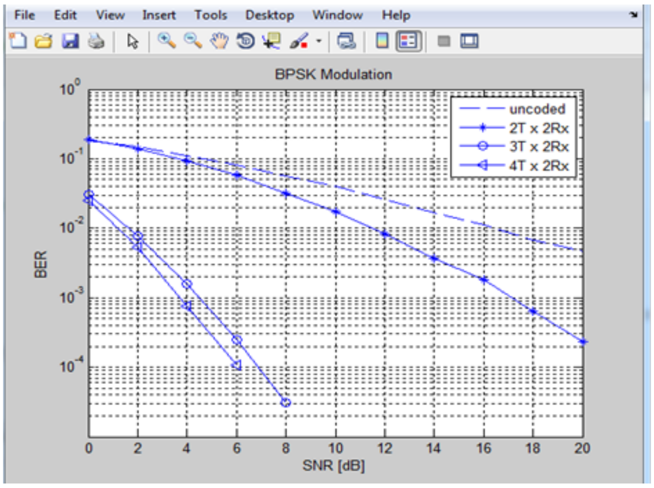

Fig.V.a BER Vs SNR of the channel estimation algorithm for STBC-OFDM systems.

VI. CONCLUSION

In this paper, the channel estimation algorithm in MIMO systems with space-time block coding was introduced. This algorithm, Channel Estimation, enables to estimate the channel transfer matrix simultaneously with the data symbols transmission. This estimation is a very simple process: just a multiplication of two matrices. The transmission with Channel Estimation algorithm is very effective in a radio channel with moderate variations: it outperforms the standard transmission with training sequence and the transmission with coding. However, when channel variations are very fast, e.g. the speed of a mobile terminal is very large, the STBC techniques get better results. Algorithm could be even more effective, if it was combined with some advanced channel estimation techniques. Moreover, for MIMO-OFDM systems, the dependence between the channel characteristics of adjacent carriers could be exploited to estimate the channel transfer matrix more accurately and enhance the system performance. Experimental results, obtained by processing the data recorded, show an average performance improvement of about 3 dB over the conventional single-transmitter scheme. Future work will focus on channel estimation schemes that exploit the structure of the Alamouti code to further reduce the computational complexity..

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