Performance Study on Coded-MIMO Wireless Systems

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Abstract: - Wireless communications is an emerging field, which has seen enormous growth in the last two decades. The next generation of broadband wireless communication systems is expected to 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 high data rates, higher mobility, and higher carrier frequencies that are needed to enable reliable transmissions over mobile radio channels. In this research study the literature review paper has been presented in order to enhance the performance of Channel Estimation in MIMO-STBC.

Keywords- pilot symbol assisted modulation; MIMO system; STBCcodes.

I. INTRODUCTION

Since 1980s, the wireless evolution has so far gone through two generations. First-generation (1G) wireless systems (e.g., AMPS, TACS and NMT) use analog transmission and support voice services only. Second generation systems (e.g., GSM, IS-95) upgrade to digital technologies and cover services such as facsimile and low data rate (up to 9.6 kbps), in addition to voice. The enhanced version of 2G systems (e.g., GPRS, HDR), sometimes referred to as 2.5G systems, support more advanced services like medium rate (up to 100kbps) circuit or packet switched data. Third generation(3G) systems (e.g., UMTS, CDMA 2000) will provide significantly higher data rates (64kbps-2Mbps) than 2.0G systems. OFDM and Space-time (ST) coding are potential candidates for the physical layer of fourth generation (4G) mobile systems.

Orthogonal frequency division multiplexing (OFDM) is a high spectral efficiency type of multi carrier modulation systems, which have many advantages over single carrier 2 systems, especially for high data rate transmission in time dispersive channels. In OFDM, the entire channel is divided into many narrow parallel sub channels, thereby increasing the symbol duration and reducing or eliminating the inter symbol interference (ISI) caused by the multipath environments. OFDM modulation is adapted for many Wireless LAN (e.g., IEEE 802.11, HIPERLAN/2) and digital video/audio broadcasting standards.

Among various transmit-antenna diversity schemes, very popular one is the ST coding that relies on multiple antenna transmissions and appropriate signal processing at the receiver to provide diversity and coding gains over un-coded single antenna transmissions. ST coding has been recently adopted in 3G cellular standards such as WCDMA and CDMA 2000.

In order to incorporate the advantages ST coding and OFDM, ST coded OFDM systems have been analyzed for broadband wireless communications over frequency selective fading channels. Space time coded OFDM systems promises an enhanced performance in terms of power and spectral efficiency. A multiple input multiple output (MIMO) system provides multiple independent transmission channels, thus, under certain conditions, leading to a channel capacity that increases linearly with the number of antenna elements. The capacity of the ST coded OFDM system (in terms of number of users or data rate) can be increased by increasing the number of ST coded OFDM terminals at the transmitter. This ST coded multiple transmit and multiple receive antenna OFDM system as ST coded MIMO-OFDM system. In this research work the signal detection and channel estimation methods for ST block coded (STBC) MIMO-OFDM systems are analyzed. A background on previous work of ST coding, ST coded OFDM systems and the channel estimation methods for ST coded OFDM systems are presented.

OFDM Structure

All communication systems are, in its simplest form, composed of a transmitter, receiver and a channel. However, an OFDM system is more complicated. The OFDM system is shown in Fig. 1.1. A brief description of the model is provided below.

The principle of any Frequency Division Multiplexing (FDM) system is to split the information to be transmitted into N parallel streams, each of which modulates a carrier using an arbitrary modulation technique. The total signal bandwidth is therefore, $N \cdot \Delta f$, where Δf is the frequency spacing between adjacent carriers. In order to analyze an

FDM system, *N* independent transmitter and receiver pairs have to be realized in the form of sinusoidal generators, making the system very complex and equally costly. However, the advent of the Discrete Fourier Transform (DFT) made this transmission scheme more plausible.

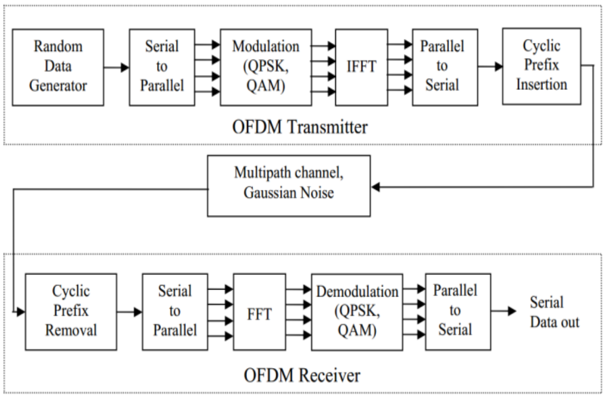

Fig. 1.1: OFDM Model used for simulations

The Fast Fourier Transform (FFT) and the Inverse Fast Fourier Transform (IFFT) are the more efficient implementations of the DFT, are utilized for the baseband OFDM modulation and demodulation process as indicated in Fig. 1.1. OFDM time domain waveforms are chosen such that mutual orthogonality is ensured even though subcarrier spectra may overlap. To prevent ISI, the individual blocks are separated by guard intervals wherein the blocks are periodically extended.

II. MULTIPATH CHANNEL MODEL

Channel Characteristics

It is known that the performance of any wireless system is affected by the medium of propagation, namely the characteristics of the channel. In telecommunications, a channel is a separate path through which signals can flow.

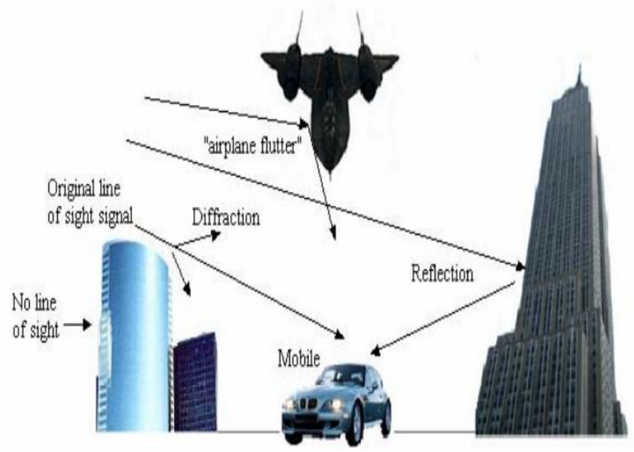

Fig. 1.2: Some channel characteristics

In the ideal situation, a direct line of sight between the transmitter and receiver is desired. Usually, the received signal is a combination of attenuated, reflected, refracted, and diffracted replicas of the transmitted signal. To top it off, the channel adds noise and if the receiver is in motion, then the Doppler Effect has to be taken into consideration. Some of these are illustrated in Fig. 1.2

Some of these characteristics are as follows:

Attenuation:

This is the drop in the signal power when transmitting from one point to another and it can be caused by the transmission path length, obstructions in the signal path, and multipath effects.

Multipath Effects:

As the name implies, multipath is the result of the original signal reaching the receiver at different times within a specific transmission time slot. The transmitted signal can take several paths to reach the receiver, that is, directly, after being diffracted or after it had been reflected off of another object. In order to simplify things, assume that the reflected and diffracted signal undergo no phase changes upon contact with the objects blocking their paths. Now the receiver will pick up the line of sight signal, and then shortly after that the diffracted signal and then the reflected signal. These are the original signals, but are delayed bit when it encountered the obstructions. This can be visualized as the original signal shifted a few times. Now each signal adds on to each other, linearly or non-linearly, and this is what the receiver picks up. Frequency selective fading occurs when reflections cause the cancellation of certain frequencies at the receiver so there may be a dip or a faded signal at the receiver. Delay Spread: Delay spread is the time spread between the arrival of the first and last multipath signal seen by the receiver. In a digital system, the delay spread can lead to inter-symbol interference (ISI). This is due to the delayed multipath signal overlapping with the following symbols.

Doppler Shift:

When a wave source and a receiver are moving relative to one another the frequency of the received signal will not be the same as the source. When they are moving toward each other the frequency of the received signal is higher than the source, and when they are moving away from each other the frequency decreases. Doppler shift can cause significant problems if the transmission technique is sensitive to carrier frequency offsets (for example COFDM) or the relative speed is higher (for example in low earth orbiting satellites).

III. LITERATURE SURVEY

SR. NO.	TITLE	AUTHOR	YEAR	APPROACH
1	BER Performance of Gray-Coded PSK-Modulated and QAM-Modulated MIMO systems	K. Rautela and N. Belwal	2019	Gray codes are used for M-ary PSK and M-ary QAM modulation technique over AWGN channel
2	Mimo-OFDM Compressed Channel Estimation Using Forward-Backward Pursuit	A. Akbarpour-Kasgari and M. Ardebilipour	2018	Forward Backward Pursuit (FBP) algorithm is reported to utilize the joint sparsity of MIMO-OFDM channels in order to increase the accuracy of estimation,
3	Low-complexity zero-forcing detector for large-scale MIMO-OFDM systems	C. Mei and W. Huang,	2017	ZF detection based singular value decomposition (SVD) used to employ power iterative method to reduce computational complexity of SVD
4	ICI mitigation in MIMO-OFDM by iterative equalization using OPT in time varying channels,	K. P. J. Sherin and E. Abhitha,	2017	A low complexity iterative method called operator perturbation technique (OPT) is utilized for MIMO-OFDM system to optimize ICI
5	Iterative decision-directed channel estimation for MIMO-OFDM system	Wenjie Zhang, Hui Li and Bin Li,	2016	An iterative decision-directed channel estimation algorithm is reported for (MIMO-OFDM) system
6	Performance scrutiny and optimization of LDPC coded MIMO OFDM systems	V. S. Jadhav and P. Sawant,	2016	A low density parity check (LDPC) group of Linear block codes decoders and large collection of data transmission and storage channels can be admitted
7	M2M Communications in 3GPP LTE/LTE-A Networks: Architectures, Service Requirements, Challenges, and Applications	F. Ghavimi and H. Chen,	2015	Presents architectural enhancements for providing M2M services in 3GPP LTE/LTE-A networks and reviews the features and requirements of M2M applications

K. Rautela and N. Belwal, [1] Higher data rate modulation scheme is one of the significant criteria but minimizing the bit error rate is one of the major aspects in wireless communication. This paper shows that using the binary reflected gray code to label the signal constellation results in the lower possible BER and SER. Modulation scheme which are skilled enough to carry more bps are more resistant to mistakes. These errors are produced mainly due to the noise and interference that occurs in the channel. The most widely used modulation schemes in wireless communication now a days are M-ary PSK and M-ary QAM. In this paper Gray codes are used for M-ary PSK and M-ary QAM modulation technique over AWGN channel and performance comparison of different modulation techniques has been shown in terms of BER and SER.

A. Akbarpour-Kasgari and M. Ardebilipour, [2] Multiple Input Multiple Output-Orthogonal Frequency Division Multiplexing (MIMO-OFDM) channel estimation is considered as of late using Compressed Sensing (CS) based techniques. Here, answered to utilize the joint sparsity of MIMO-OFDM channels utilizing Forward Backward Pursuit (FBP) algorithm. So as to expand the exactness of estimation, answered to consider the regular sparsity of MIMO channels in each progression and to misuse basic sparsity in the framework display. Besides, the regressive advances enhance the precision by overlooking shrewdness recently assembled molecules. Simulation results speak to the prevalence of the proposed FBP-based channel estimation approach as opposed to the traditional CS-based methodologies.

C. Mei and W. Huang, [3] Consider the uplink of multi-input multi-output (MIMO) orthogonal frequency division multiplexing (OFDM) systems. At the point when the quantity of antennas is adequately huge, the zero-forcing (ZF) detection performed at the Base station (BS) is close ideal to demodulate data symbols transmitted by clients over each subcarrier. In any case, it requires network reversal to play out the ZF location particularly when the quantity of clients and subcarriers are substantial. In this work, adopt singular value decomposition (SVD) based ZF detection and utilize power iterative strategy to lessen computational complexity of SVD. Besides, exploit the way that the channel grids of adjacent subcarriers are like decrease the required number of cycles in the power iterative technique. In particular, the underlying vectors in the power emphasis are substituted by the solitary vectors acquired for the channel network comparing to the past subcarrier, instead of the randomly generated vector. It appears through computer simulations that the proposed technique lessens the quantity of cycles by 40%~70%, which fundamentally diminishes the computational complexity in broadband OFDM systems.

K. P. J. Sherin and E. Abhitha, [4] Time variety of channel in orthogonal frequency division multiplexing (OFDM) framework crushes the orthogonality among subcarriers, and presents inter carrier interference (ICI). Distinctive strategies have been utilized to prevent ICI, however the computational complexity of a few techniques is high. In multiple-input multiple-output (MIMO) framework the complexity is much higher. This examination announced a low complexity iterative strategy called administrator irritation method (OPT) is utilized for MIMO-OFDM framework to decrease ICI under the presumption of straight time-differing channels. It requires channel estimation dependent on straight time-changing channel demonstrate. Time-domain synchronous-OFDM suits for this proposed iterative system since its receiver can undoubtedly assess straight time-fluctuating channels. Simulation with QPSK modulation demonstrates the execution of the proposed technique. Here think about LTI and LTV execution for QPSK modulation. Result demonstrates that the iterative strategy has about comparable execution for both LTV and LTI channel regardless of their channel condition. Likewise better BER and MSE execution for both LTV and LTI algorithm is accomplished when the Doppler frequency is 10Hz.

Wenjie Zhang, Hui Li and Bin Li, [5] in this examination, an iterative choice coordinated channel estimation algorithm is proposed for multiple-input multiple-output orthogonal frequency division multiplexing (MIMO-OFDM) framework. The algorithm is partitioned into two sections: channel forecast and channel estimation. The fundamental thought of the channel forecast is to utilize the auto-relapse show and from the earlier data of the channel to foresee channel state. At that point channel state is evaluated by utilizing the channel forecast data and received signal. The simulation results demonstrate that the proposed strategy can build the exactness of the channel estimation and enhance the execution of the MIMO-OFDM framework. The BER of the iterative DD-CE technique has practically 10% advancement when the SNR is 30 and practically 2dB enhancement of estimation precision than traditional DDCE strategy.

V. S. Jadhav and P. Sawant, [6] The implementable decoders and large collection of data transmission and capacity channels can be admitted in the meantime utilizing low thickness equality check (LDPC) gathering of Linear block codes. Survey a portion of the LDPC development methods and encoding issue for LDPC codes. Additionally certain unique classes of LDPC codes which will settle encoding issues will be presented. Execution examination and design improvement of LDPC coded multiple information multiple output(MIMO) orthogonal frequency division multiplexing(OFDM) has been considered. The devices of thickness development with blend Gaussian approximations are utilized to streamline LDPC codes which are not customary and to process least operational signal-to-noise proportions (SNRs) for ergodic MIMO-OFDM channels. Specifically, the streamlining is improved the situation different MIMO-OFDM framework arrangements, which incorporate an alternate channel models and distinctive demodulation conspires; the execution which is upgraded is checked with the relating channel limit. The iterative message passing disentangling algorithm which gives ideal execution will be displayed. The execution of turbo-iterative receiver that comprises of a delicate most extreme a posteriori (MAP) demodulator will be displayed. From the LDPC profiles that already are advanced for ergodic channels, build little block-estimate unpredictable codes for outage MIMO-OFDM channels.

F. Ghavimi and H. Chen, [7] Machine-to-machine (M2M) communication is a rising innovation to give pervasive availability among devices without human intervention. The cell networks are viewed as a ready-to-utilize foundation to execute M2M communications. Be that as it may, M2M communications over cell present huge difficulties to cell networks because of various data exchanges, assorted applications, and an expansive number of connections. To help such an extensive number of devices, M2M framework design ought to be very power and spectrum productive. In this examination give a far reaching study on M2M communications with regards to the Third-Generation Partnership Project (3GPP) Long-Term Evolution (LTE) and Long-Term Evolution-Advanced (LTE-A). More specifically, this examination presents compositional upgrades for giving M2M services in 3GPP LTE/LTE-A networks and audits the highlights and necessities of M2M applications. In addition, the signal overheads and different nature of-service (QoS) necessities in M2M communications likewise merit our consideration. Address M2M challenges over 3GPP LTE/LTE-An and furthermore distinguish the issues on different random access overload control to dodge blockage brought about by random channel access of M2M devices. Diverse application situations are considered to illustrate modern M2M applications. At last, present conceivable empowering innovations and point out the directions for M2M communications examine.

IV.PROBLEM IDENTIFICATION

In previous research study, PSAM estimation method had been proposed for MIMO based on orthogonal STBC codes. The transmitter just inserts known equally and optimally spaced pilot symbols in data information block. The combined signal is coded using orthogonal STBC code. The transmitted signal is corrupted by slow fading and additive noise. The slow fading channel is modeled by Jakes model; also it is chosen to be constant over the STBC code word period. The receiver estimates andinterpolates the channel measurements provided by the pilot symbols in order to obtain the amplitude and the phase reference for detection. Simulation results show that the channel estimation based on PSAM technique was providing the improvements in terms of BER for the two MIMO schemes. Further these results can be improved with the help of our proposed work.

V. CONCLUSION

Wireless communication is one of the most active areas of research over the past and the current decades. A variety of services have been oared in such a context, starting from Voice, continuing to Data and now to Multimedia. Significant reductions in cost and time can also be achieved using wireless solutions, providing even several benefits to the users in terms of mobility and edibility in the placement of terminals. In fact, wireless mobilesystems have begun to permeate all areas of our daily life and are therefore required to provide high-speed, high-capacity and high-quality services with performances closer to those afforded by wire line systems. This evolution has been made possible by academic and industrial Research and Development (R&D) labs with the implementation of three generations of cellular systems.

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