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Engineering

SFBC-OFDM SYSTEM FOR TRANSMIT DIVERSITY OF LTE

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ABSTRACT MIMO wireless communication is nothing but the communication over wireless links which are furnished by several antennas at both the transmitting and receiving end. Space frequency block coding is one of the promising technique using which that greatly improves the performance is prominently improved in wireless communication systems by using several antennas at the transmitting part and receiving part. More data can be transferred at the same time with the help of multiple transmitter and receiver. MIMO technique significantly reduces the properties of channel fading.

KEYWORDS : LTE, SFBC, MIMO, Transmit diversity

I. INTRODUCTION

2G, 3G, and now 4G are the progressive generations of mobile network in wireless communication systems. 4G LTE (Long Term Evolution) wireless communication system is the new technology which is driven by the extensive need for reliable and fast communications over the wireless communication channel. The next generation broadband communication structures should provide data processing which is less intricate, robust and stronger performance and higher data rate. The broadband wireless channel will typically be a non line-of-sight (LOS) channel that contains much weakening like frequency-selective fading and time-selective fading.

To take stock of these experiments, one advantageous resolution is to merge two dominant techniques namely orthogonal frequency division multiplexing (OFDM) modulation techniques and multiple-input multiple-output (MIMO) antennas. International Mobile Telecommunications (IMT)-2000 familiarized Global standard for 3G. 3G Network was adopted by many countries. But 3G network has higher dormancy, lower speed. Third Gen Partnership Project (3GPP), Ground-breaking systems beyond 3G is currently developed by LTE. IEEE 802.16 based Worldwide Interoperability for transmit diversity directs the same data via various antennas; also every antenna stream practices diverse coding and diverse frequency resources. Improvement is seen with transmission quality being more strong and enhanced signal-to-noise ratio.

Microwave Access (WiMAX) is also developing towards 4G through 802.16m. 4G LTE is good enough for facilitating mobile broadband speeds upto ten times quicker than 3G. This contains online gaming, real-time web browsing, video services and social media. LTE is constructed upon the basis of GSM-UMTS-HSPA technology. Complementary to the 2G and 3G radio access networks, which are connected to the circuit-switched domain of the 3GPP core network, the E-UTRAN only connects to the Evolved Packet Core (EPC). The EPC is a multiple access core network which is based on internet protocol (IP). It is well demarcated around the 3 significant models of mobility, security and policy management. It gives user terminals with improved delivery schemes between diverse radio access technologies.

II. SFBC-OFDM

Space Time Frequency codes are obtained as a result of coding through multiple OFDM blocks. This was first projected for two transmit antennas and later established for multiple transmit antennas. Full range is delivered through this scheme only if the number of transmit antennas are greater than the encoded OFDM blocks. Space Frequency Block Coding (SFBC) is like space time coding, with the variance is that the encoding in case of space time is done in time domain but space frequency takes place in frequency domains. Space frequency coding is relevant to OFDM and other frequency domain transmission schemes. Space-frequency block codes were shown to be much real in frequency discriminating fading channels as the code is simultaneously transmitted space-frequency block coding with OFDM enhances the quality of transmission of wireless communications. The source symbols of SFBC-OFDM are not coded transversely two symbol periods, but instead the source symbols are coded across two successive frequencies contrasting to STBC-OFDM.

Space Frequency Block codes were appeared to be much viable in frequency selective fading channels as the code is at the same time transmitted space frequency block coding with OFDM upgrades the nature of transmission of wireless communication. Unlike STBC-OFDM, the source images of SFBC-OFDM are not coded across more than two image periods, but rather the source symbols are coded crosswise over two back to back frequencies. OFDM is a promising innovation in broadband wireless communication because of its capacity in relieving multipath impacts. It is normally utilized for high information rate remote correspondence because of its capacity to combat frequency selective fading brought about by the wideband radio fading channels & to expect Inter Symbol Interference (ISI) and to give adequate strength radio channel impairments. On account of high limit transmission of OFDM, it has been connected to computerized transmission framework, for example, advanced sound telecom (DAB) framework, advanced video broadcasting TV (DVB-T) framework, unbalanced computerized supporter line (ADSL), ultra-wideband (UWB) framework, IEEE 802.11 a/g. Remote Local Area Network (WLAN), IEEE 802.16 (WiMAX) frameworks and HIPERLAND 2 (High Performance Local Area Network). It is a phenomenal procedure to diminish the impacts of frequency selective fading by partitioning the transmission transfer speed into many narrow band subcarriers. In MIMO communication, different antennas are utilized to expand throughput and insusceptibility to fading, interference, and noise. OFDM joined with MIMO innovation is an appealing for current mobile communication system because of its capacity to support high information rates, vast limit, and robustness to multipath fading.

In LTE, transmit diversity is utilized as a reserve alternative for certain transmission modes, for example, when spatial multiplexing (SM) can't be utilized. Control channels, for example, PBCH and PDCCH, are furthermore communicated utilizing transmit diversity. For 2 antennas, a frequency band adaptation of the Alamouti codes Space Frequency Block code, is used, while for 4 antennas, a mix of SFBC and frequency switched transmit differences (FSTD) is used. Multiple Input Multiple Output (MIMO) system utilizing numerous transmit and receive antennas will inarguably assume a major part in the enhancement of next generation broadband wireless communication.

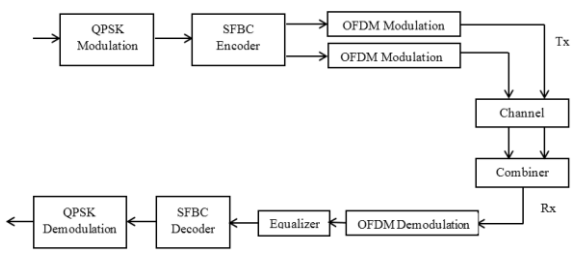

Figure 1: Block diagram of SFBC-OFDM

By exploiting the bigger number of stimulating ways concerning the transmission and reception antennas, the hindering impacts of channel fading be altogether diminished. It has been confirmed that MIMO system bid a huge potential limit increment contrasted and single receiving antenna system. To endeavor this limit increment, a significant number of MIMO adjustment and coding techniques, which are explained as space-time (ST) codes. The mix of MIMO and OFDM turns into a key improved work for the downlink channel in 4G Long-Term Evolution (4G-LTE).

III. SYSTEM MODEL OF SFBC-OFDM FOR LTE

Transceiver of SFBC-OFDM system, the transmitter consists of QSPK Modulator, SFBC Encoder, QFDM Modulator. The Receiver comprises of OFDM Demodulator, Equalizer, SFBC Decoder, QSPK Demodulator.

Transceiver likewise comprises of a combiner. The figure demonstrates the block diagram of SFBC-OFDM Transceiver framework.

At transmitter,

The baseband signal speaking to a downlink physical transmitter direct is characterized as far as various processing stages. Every single wireless communication system utilizes a modulation scheme to outline coded bits. Diverse sorts of modulation schemes are utilized as a part of SFBC-OFDM transceiver like QPSK, 16QAM, 64QAM. For LTE System, the coded bits are at first mixed with the scrambling grouping which is produced utilizing the LTE framework work.

Scrambling in LTE downlink comprises of increasing (select or operation) arrangement of coded bits which are taken as contribution by the bit level scrambling succession. Each of the code words which are mixed is transmitted on the physical channel. The mixed bits are regulated to create the complex esteemed balance images. Scrambling the bits makes them less inclined to impedance as the procedure makes the estimation of bits to be transmitted as the pseudo arbitrary.

One tweak image can speak to n bits contingent upon the adjustment sort (n =6 for 64QAM, n= 4 for 16 QAM, n=2 for QPSK). Then complex valued modulated symbols are mapped onto one or several transmission layers. The no. of transmission layers depends on the no. of antenna ports.

The complex esteemed tweaked images are precoded on each layer for transmission on the receiving wire ports. Precoding is done to receive to the channel condition. The transmission is precoded as per the recurrence reaction of the channel. Precoding is done such that the first flag is gotten at the beneficiary end after the transmission experiences the recurrence reaction of the channel. Thus we apply the SFBC for precoding which does not influence the flag because of the recurrence reaction as the encoding procedure is done in the recurrence space in the event of SFBC.

The process of SFBC is completed on match of complex esteemed regulation images. Consequently, each combine of balance images are charted specifically to OFDM subcarriers of 1st receiving wire while charting of each match of images to comparing subcarriers of 2nd reception apparatus are contrarily requested, complex conjugated and marked turned around. For fitting gathering, portable unit ought to be informed about SFBC transmission and straight action must be connected to the gotten flag. The images transmitted from the 2 transmitted reception apparatuses on each combine of adjacent subcarriers are described as below.

$$X = \begin{bmatrix} x(1)^{(0)} & x(1)^{(1)} \\ x(2)^{(0)} & x(2)^{(1)} \end{bmatrix} = \begin{bmatrix} s_0 & -s_1^* \\ s_1 & s_0^* \end{bmatrix}$$

where $x(k)^p$ symbolizes the symbols transmitted from antenna port 'p' on the kth subcarrier.

The received symbol can be stated as follows:

$$y = Hs + n$$

$$\begin{bmatrix} y_0 \\ y_1^* \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} h_{00} & -h_{01} \\ h_{11}^* & h_{10}^* \end{bmatrix} \begin{bmatrix} s_0 \\ s_1^* \end{bmatrix} + \begin{bmatrix} n_0 \\ n_1^* \end{bmatrix}$$

Where, h_{ij} channel response of @ symbol 'i' transmitted from antenna 'j', & 'n' is the additive white Gaussian noise.

In the event that there are two transmitters and one recipient in the framework then the channel reaction network will be 2x1 which relies on upon the plan received. The complex esteemed precoded images are mapped to asset components for every radio wire port. At that point for every receiving wire ports complex esteemed time area OFDM signs are created.

In MISO and MIMO designs, space recurrence piece code (SFBC) based layer mapping and precoding are done to acquire transmit differing qualities when at least two radio wire ports are utilized at eNodeB according to the 3GPP LTE remote standard. It is expected that 2 receiving wire ports are utilized at eNodeB.

At receiver,

After the era of OFDM symbols they experience asset mapping. At that point they are transmitted through the channel. Beneficiary is intended for 2x1 antenna system and for QPSK modulation.

In the decoder, the received signal is nourished to the channel estimator. The assessed coefficients of the channel together with the combiner are given to the equalizer which expels the impact of channel. On the off chance that r0 and r1 are the signs gotten at the decoder, then the first flags can be recouped back by taking out the impact of the channel as,

$$s0 = \frac{r_0 + r_1^*}{2} \qquad s1 = \frac{-r_0^* + r_1}{2}$$

IV. SIMULATION RESULTS:

This section provides the analysis of the results obtained on implementation in Matlab. The information source is encoded using SFBC, the constellation symbols which are as shown in the following scatterplots are transmitted through 2 antennas. The two streams of SFBC are then OFDM modulated which will alter the size of the symbols to be transmitted according to the FFT size adopted. The simulation results shown in the following plots are done with the input fields Nfft which is set to 1024, the sampling rate is set to 15.36MHz. A normal cyclic prefix is considered.

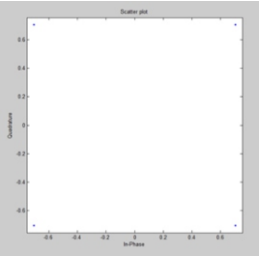

Figure 2: Scatterplot of QPSK

Data modulation is done using QPSK where in it will have 4 constellation points occupying 4 quadrants. This is as shown in the figure2.

OFDM symbols are transmitted over 2 transmitters. The scatterplot of the OFDM symbols are as shown in the figure 3. When the same OFDM symbols are received at the receiver with the channel effect that can be eliminated using the equalizer. They also will have the effect of DC null and phase offset. So by applying the algorithms for DC cancellation and Phase offset correction.

The bit error rate of the SFBC symbols is shown in Figure 4 that is transmitted over AWGN channel (blue curve) , Rayliegh channel (green curve), Rician channel (red curve).

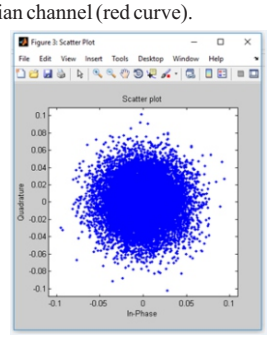

Figure 3: Scatterplot of OFDM

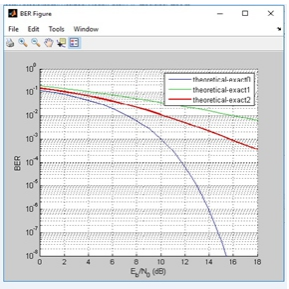

Figure 4: Bit error rate of SFBC symbols over different channels

V. CONCLUSION:

The primary goal of LTE is that, the LTE organize like every single cell framework is intended to work in rare and significant authorized range. This implies it is very improved and a ton of many-sided quality is vital for the most elevated conceivable productivity. At the point when the norms body needs to pick amongst effectiveness and straightforwardness, they generally pick productivity to make the best utilization of this range.

LTE utilizes all the time on the downlink for passing on information. The downlink PHY is completely booked so there are no crevices because of intervention or conflict with the exception of the underlying access on the arbitrary get to methodology. The downlink conveys different coherent channels more than one connection, so a considerable measure of data is multiplexed together in one transport hinder, instead of different systems where any given bundle is just conveying one sort of data at a given time, for example, in a control plane or a user plane.

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