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SUPERDIRECTIVE BEAMFORMING FOR MULTIUSER MIMO-OFDM INTERFERENCE CHANNELS WITH MULTIPATH DIVERSITY

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ABSTRACT-MIMO-OFDM is the leading air interface for 4G and 5G broadband wireless communications. MIMO-OFDM stands for multiple input multiple output –Orthogonal frequency division multiplexing. MIMO technology will multiplies capacity by transmitting altered signals over multiple antennas, and orthogonal frequency division multiplexing (OFDM), which splits a channel into a huge number of strictly spaced sub channels to offer more reliable communications at extraordinary speeds. Beamformingsystem is a technology which lift the system capacity without developing the complexity of the mobile terminals. Superdirectivebeamformers will maximize the array gain, or the directivity, for a principle wanted direction, whiledestroying noise coming from all other directions. The proposed method present superdirectivebeamformers with MIMO-OFDM system that will increase gain and directivity in the principle direction and defeat the signal from other direction. Simulation results validate that the proposed method significantly outperform the conventional beam forming technique for MIMO-OFDM system.

Keywords- [Beamforming, Superdirective Beamforming, Multiplexing]

1. INTRODUCTION

Beamforming for a multiuser MIMO interference channel will share a single spectrum simultaneously for communicating between a numbers of terminals [1]. Each multi-antenna transmitter strives to direct its data to only one multielement receiver in the presence of interference from all the other users' transmitters. OF DM is a well-known technique for high data rate wireless transmission. In order to increase the diversity gain and to boost the system capacity on time variant and frequency selective channe lOFD Mmay be united with antenna arrays at the transmitter and recei ver. Whicheffects in a multiple-input multiple-output (MIMO) configuration.Beamforming in MIMO-OFDM technology will increase the directivity, reduce the BER of the received signal. Conventional beamforming includepeak Rx-BFs for constrained SNR expansion when the Tx-BFs are well-known, Jointlyimproving the Tx and Rx beamformers from constrained SNR expansion and for combined optimization of Tx-Rx beamformers but combines constrained SNR and signal-to interference-plus-noise ratio expansion [1].Three beamforming for multiuser MIMO-OFDM interference channel will improve multipath diversity using the known method of applying an LCP matrix. Second algorithm may be superiortothe third algorithm for quasi-realistic channels and also it desires fewer feedbacks. The first algorithm is the simplest related to other two also it has the lowermost feedback rate. But its performance is inferior associated to the other two algorithms and some existing designs. In order to improve error performance, precoder matrix and sphere decoder is placed at transmitter and receiver respectively. This is to increase multipath diversity gain. In conventional beam forming gain and directivity have got limitation. Inorder to further improve directivity and gain conventional beam forming is replaced by Superdirectivebeamforming[2]. It will increase directivity in a particular direction and suppress the signal from other direction. Sperd irective beam forming with MIMO-OFDM is more efficient compared to other technique.

The downtime of the work is discus as follows. In part II, provided details about related works. Then, discussed about the proposed method in part III. In partIV, the proposed algorithm through simulations is evaluated. Last, presented the conclusion for this proposed framework in part V.

2. PRELIMINARIES

There has been great deal of research on increasing gain and directivity of MIMO-OFDM. A few method among are beamforming design for mean-squarederror (MSE) minimization, weighted sum rate maximization, and maximization of the sum signal power across the network divided by the sum interference power. In MSE minimization, the problem led to an iterated second-order cone programming routine. For the weighted sum rate maximization of, the constrained problem was transformed to an unconstrained problem and resolved by a gradient descent algorithm. For last one the sum signal power divided by sum interference powerwas shortened by using an alternating maximization method.K.-K. Wong,R.-K. Cheng, K. Letaief, And R. MurchIntroduced the use of placing adaptive antenna at mobile station (MS) and base station (BS)[3], operating in association with orthogonal frequency division multiplexing (OFDM). This system help to increase capacity and reduction in average error probability compared with conventional system. Smart or adaptive antenna increase spatial diversity to compensate for channel damages without increasing the transmitted power or bandwidth. This is one of the possible approach to increase system capacity through the use of adaptive antenna.

The work done in the Solution of the Multiuser Downlink Beamforming Problem With Individual SINR Constraints, address the problem appear in joint downlink beamforming [4] in the power controlled network, in which independent data streams are transmitted from a multiantenna base station to several decentralized single antenna terminals. Here there is a limitation on transmit power and channel state information is available at the transmitter. The design goal is to adjust the beamformers and transmit powers according to individual SINR requirements. There are two closely related optimization problems, first one is to maximize jointly achievable SINR margin under total power constraint. Next is to minimizetotal transmission power while satisfying a set of SINR constraint. Here both problems are solved within a unified analytical framework. The main idea in Zero-Forcing Methods for Downlink Spatial Multiplexing in Multiuser MIMO Channels[5]is to designtwo Constrain for closed-form solutions of the general multiuser MIMO channel. The first is referred as “block –diagonalization,” which is the generalizations of channel inversion when there is multiple antenna present at each receiver. It is easily adapted to optimize for either maximum transmission rate or minimum power and approaches the optimal solution at high SNR. The method is known as “successive optimization,” which is an alternative method for solving the power minimization problem one user at a time, and which yield superior results in some situation. Both of this method has limitation. They are limited to cases where transmitter has more antennas than all receive antennas combined.In order to overcome this situation,there is a third methodin which a framework is proposed for coordinated transmitter –receiver.

3. PROPOSED WORK

In the proposed work the gain and directivity of MIMO-OFDM system is increased by using superdirectivebeamforming technique. It will increase the directivity towards the principal direction and suppress the signal coming from other direction.

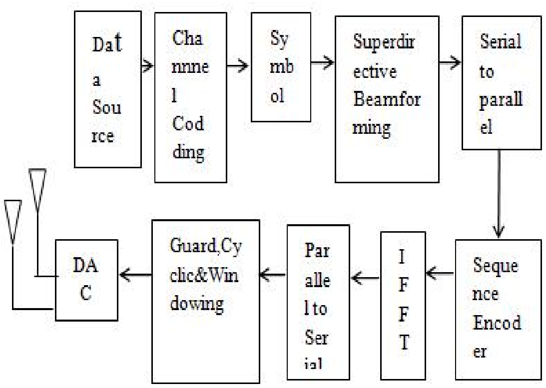

Figure 1- Block diagram for Simulated MIMO-OFDM with superdirectivebeamforming Transmitter

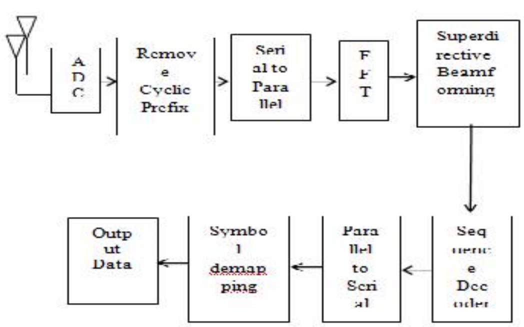

Figure 2- Block diagram for Simulated MIMO-OFDM with superdirectivebeamforming Receiver

Delay-and-sum beam forming, superdirectivebeamforming, differential microphone arrays, and frequency-invariant beamforming are different type of beamforming.It is well known that a superdirectivebeamformer, which maximizes the directivity factor of the array, is sensitive to uncorrelated noise, especially at low frequencies and for small-size arrays.

At the transmitter, the consumer information bit sequence is first exposed to channel encoding to cut the probability of error at the receiver owed to the channel effects. Then the bits are mapped to symbols by using technique like BPSK, QPSK, 16PSK, 256PSK. The symbol sequence is converted to parallel format and it is encrypted for security purpose by using encoder and IFFT (OFDM modulation) is applied and the sequence is once again converted to the serial format.

Guard time is delivered between the OFDM symbols and the guard time is packed with the cyclic extension of the OFDM symbol. To make the fall-off rate of the spectrum sharper windowing is applied to the OFDM symbols. Using a DAC the resulting sequence is converted to an analog signaland delivered on to the RF modulation stage. The subsequent RF modulated signal is, then, transferred to the receiver with the transmit antennas.

Superdirectivebeamforming are often desirable due to its intrinsic ability to offer high directivity with a small array aperture [2].

The directivity factor is defined as

$$D(f,\text{¤}) = \sum_{n=1}^{N} w_n(f) e^{j\frac{2\text{®}f}{c}(n-1)d\cos\text{¤}}$$

and that the horizontal directivity pattern is given by

$$D(f,\Phi) = \sum_{n=1}^{N} w_n(f) e^{j\frac{2\Pi f}{c}(n-1)d\cos\Phi}$$

Using the filter-sum weight vector, w(f), and defining the propagation vector as

$$d(f) = \left[1.......e^{-j\frac{2\text{®}f}{c}(n-1)\cos\text{¤}} .....e^{-j\frac{2\text{®}f}{c}(N-1)d\cos\text{¤}}\right]^T$$

We can formulate the directivity pattern in matrix notation as

$$D(f,\text{¤}) = \left[w(f)^H d(f)\right]^*$$

When signal is transmitted using MIMO-OFDM technology, and superdirectivebeamforming is applied before transmitting, BER will decreases and directivity increases. At the receiver section receiver beamforming is applied before decoding.

4. PERFORMANCE EVALUATION

Our proposed method gives high performance compared to other method. It has high gain and directivity. Superdirectivebeamforming MIMO-OFDM is one of the emerging technologies that will change the future communication. This section will compare performance of Superdirective MIMO-OFDM system with Conventional Beamforming. MIMO-OFDM is used in 4G and 5G mobile communication. At low frequency Superdirectivebeamformer have spatial selectivity so it is used in positioning.

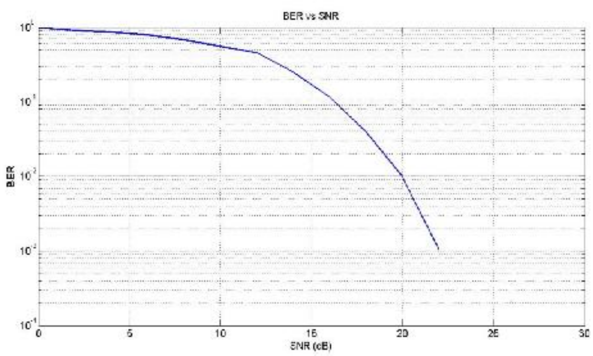

Figure 3- Optimal Rx-BFs For Constrained SNR Maximization When TheTx-BFs Are Known

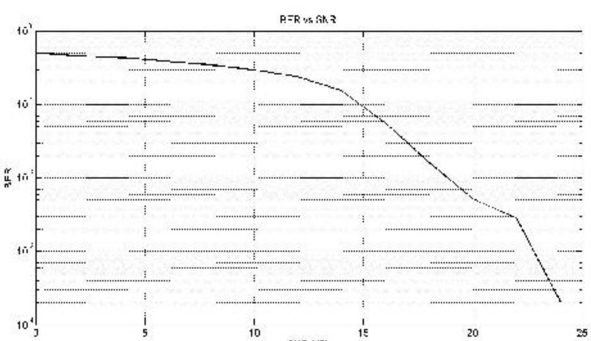

Figure 4- Joint Rx-BF AndTx-BF for Constrained SNR Maximization

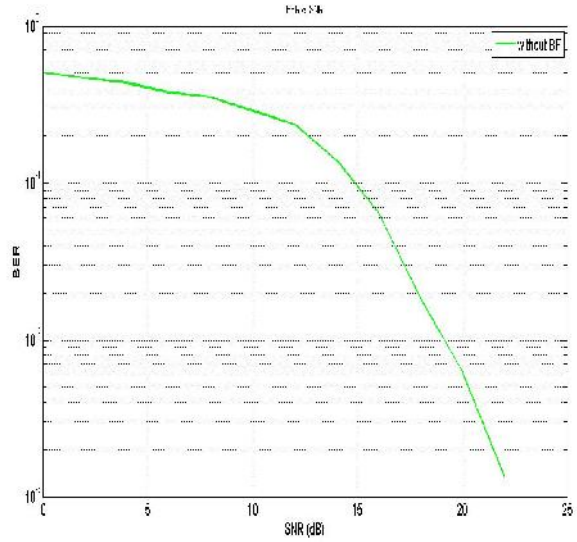

Figure 5- Tx-BF And RX-BF Design For Joint Constrained SNR Maximization and SINR Maximization

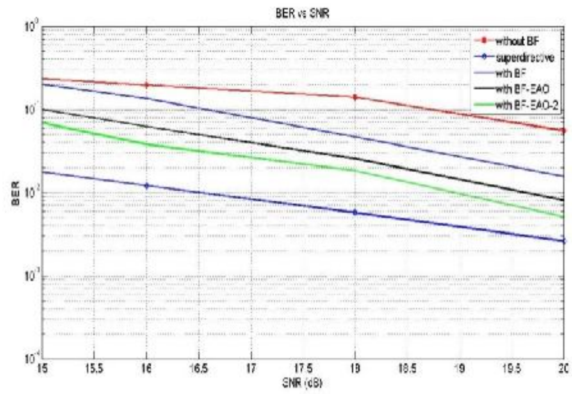

Figure 6- comparison between superdirectivemethod with conventional method

The Bit error rate performance of the optimized beamformer is depicted in Fig.3, Fig.4, Fig.5 verses average SNR. This Figure represents three method of beamforming. Fig.6. compare conventional beamforming with superdirectivebeamforming.From the graph it is clear that SuperdirectiveBeamforming with MIMO-OFDM have low BER and high SNR compared to other method. The BER is very high when Beamforming is not applied. The efficiency of communication increases when beamforming is applied;it is further increased by using the extended alternating optimization (EAO) algorithm for a multi-objective optimization. BER of the received signal is low for when multiobjective optimization by the fixed point method is applied. It is efficient than other two method. When superdirectivebeamforming is applied during transmission and after reception,the BER is far better than all other method. It haslow BER compared to conventional beamforming technique.

CONCLUSION

In this proposed work SuperdirectiveBeamformingwith MIMO-OFDM is used for communication. When Superdirectivebeamforming is applied before transmission and after reception of signal,the gain and directivity will increase in the principal direction and suppress the noise coming from other direction. This work shows that transmission with superdirectivebeamforming have low BER compared other method .The simulated result give a graphical representation of BER verses SNR of existing method and proposed method. Due to high directivity of superdirectivebeamformer it is used in many application such as loud speaker positioning, matched loudspeaker etc.

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