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PERFORMANCE ANALYSIS OF FOUR USER MIMO DATA TRANSFER IN INTERFERENCE ALIGNMENT NETWORKS USING QOSTBC

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Abstract: In Wireless communication system requires high spectral efficiency, high diversity order and degree of freedom. Interference in the wireless networks reduces the signal to noise ratio to less. So, we consider interference cancellation for a system with more than two users when users know each other channels. The goal is to utilize multiple antennas to cancel the interference without sacrificing the diversity or the complexity of the system. To overcome that we are using OC (Opportunity Communication) base IA networks. The previous method uses RCR-OIAUS (Random Complexity Reduced Opportunity Interference Alignment User Selection) is the algorithm used for SWIPT (Simultaneous Wireless Information and Power Transfer). This algorithm reduces the complexity of calculations when large number of user with less number of users adapted to the network in. In this algorithm particular portion is selected to be searched. To overcome this drawback Lloyd Quantization is introduced. By reducing the random time integer we can neglect the noise in low frequencies.

Keywords: MIMO, Interference Alignment (IA),Llyods Algorithms.

I. INTRODUCTION

The MIMO technology has gained popularity because of its powerful performance enhancing capabilities which uses multiple antennas at the receiver and transmitter. Due to the multi-path fading in wireless channels communication is impaired. Three kinds of shifts can happen in the transmitted signal while arriving to the receiver because of the electromagnetic waves. They are differing in angles, differing in time delays, differing in frequency. Because of these three shifts transmitted signal travels in multi-path. The power of the signal differs because the angle spread and delay spread and Doppler spread in space and frequency and time. This difference in the signal is called as fading. Fading affects the quality and reliability of the wireless communication. In this condition designing high data rate, high reliability wireless communication systems challenging because of the limited power and scarce frequency bandwidth.

In wireless communication system design MIMO technology constitutes a breakthrough. To overcome the challenges posed by the impairments in wireless channel and resource constraints MIMO technology offers number of benefits. In conventional single antenna wireless systems the time and frequency dimensions are exploited, in the MIMO technology the spatial dimension is exploited caused by the multiple antennas at the transmitter and receiver.

Even though the advantages of MIMO systems have been acknowledged through the transmit diversity methods have been incorporated into wireless standards. It is a advantage transmit diversity on cellular base station, for other scenarios it may not be practical. The reason is size, cost and hardware limitations.

II. RELATED WORKS

[1] For Time-Correlated MIMO on the minimum differential feedback Rayleigh Block-Fading Channels. In this the differential feedback rate is derived with the presence of channel estimation errors and quantization distortion. Lloyd's algorithm used to increase the ergodic capacity [2] Cooperative Algorithms for MIMO Interference Channels. For MIMO Interference channels INL (Interference Pulse noise leakage) algorithm is introduced. When the noise is specially white and negligible. The transmit pre coders and receive spatial filters can jointly optimizes using joint minimum mean square error .[3] Achieving the Welch Bound With Difference Sets. By considering a codebook having N unit-norm complex vectors and K dimensional space. The maximal cross-correlation amplitude (Imax) is minimized by the code book is often. Analytical optimal codebook meeting were constructed in the case of Welch lower bound numerical search method developed. [4] Beam Tracking is used for Interference Alignment in MIMO Interference Channels which is slowly fading. Beam tracking algorithm is developed based on linear formulation for interference alignment to reduce the fading in the beam design for the signal space interference alignment. It computes the current time beam interference-aligning beam forming vectors based on previous vectors . During the predictively updating phase it consider the channel difference between two time steps , and yields significant reduction for the calculation.[5] Interference Alignment with Limited Feedback. For single-antenna interference networks operating over time-selective channels and showed that this scheme achieves full spatial multiplexing gain. This depends, critically on the assumption of every source and related destination knowing all the channels in the network perfectly result.

III. EXISTING METHOD

Interference alignment schemes are used to get the full multiplexing gain of K-user interference channel. In the existing system focuses on the where each receiver knows its transmitter and sends the feedback to all other transmitters in a limited number of bits about this information. It is for a multiple input and multiple output channel which has K-user. When the feedback bit rate sufficiently fast with SNR ratio the full sum degrees of freedom of the interference channel can be achieved.

SWIFT (simultaneous wireless information and power transfer) is a technique to reduce the fading caused by the interference. It is based on the idea of reuse the interference. It can be used in both user based and also antenna based selection. In user based and antenna based selection all the possible combinations of selected users brute-force search is adopted to find the optimal solution. The computational complexity increases when the sleeping mode users are less in MIMO system. In OIAUS algorithm the performance enhancement is slow when applied to practical system because of the no of available solution is large and computational complexity is high . RCR-OIAUS is the algorithm used in this technique to reduce the calculation complexity. In the RCR-OIAUS algorithm a portion of available solution is selected to form the reduced set of solutions. This calculation is for the both channel selection user based also antenna based selection. The SINR ratio is increased by reducing the interference fading.

IV. PROPOSED SYSTEM

The minimum differential feedback rate is derived in the closed-form expression to get the maximum multiplexing gain for the time-correlated MIMO interference channels. For this the relationship between the number of differential feedback and sum rate should be analysed. Sum-rate performance loss upper bound with the differential feeback bits is provided in addition to it. To verify the theoretical analysis the alternating-minimization precoding scheme and differential feedback scheme are used by a practical IA system. Furthermore to verify the theoretical calculation a differential feedback scheme using Lloyd's algorithm and fixed feedback bits are used.

BLOAK DIAGRAM

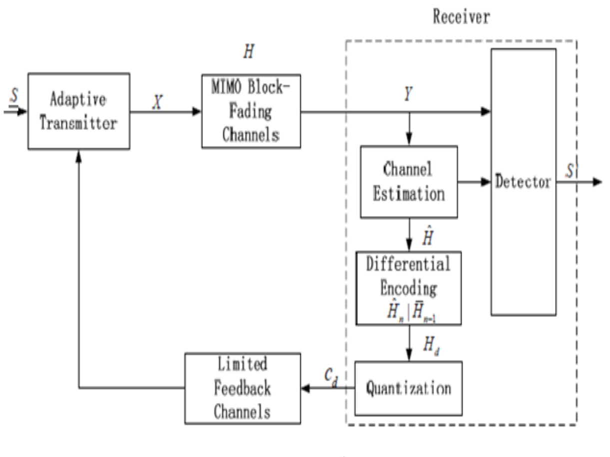

Fig.1 block diagram of proposed method

We consider a MIMO system having K-user over time correlated block-fading channels as shown in figure. Assume that each transmitter S_i (i value varies from 1 to K) has *Nt* antennas and each receiver D_i (i value varies from 1 to K)has *Nr* antennas. The ith transmitter $S_i$transmits$d_i$independent spatial data streams to its corresponding receiver D_i. The block-fading channel coefficients $H_{ik}(n)$, i, $k = 1, 2, \ldots, K$ are constant throughout the time interval and temporal correlated with each other in different block indexes n.

SYSTEM MODEL

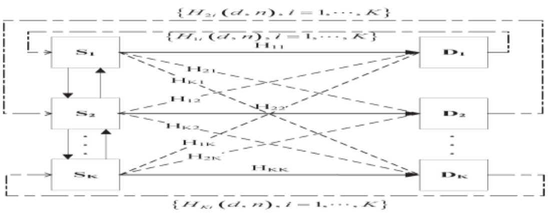

Fig.2 MIMO system having K users

Thus, the received signal at the ith receiver can be written as

$$y_i(n) = H_{ii}(n)X_i(n) + \sum_{k\neq i} H_{ik}(n)X_k(n) + n_i(n)$$
$$i = 1,2, \ldots K$$

y_i denotes a N_r x1 received signal vector, H is a N_r x N_t channel fading matrix with independent entries obeying complex Gaussian distribution $CN(0,\sigma_h^2)$ and x represents a N_t x 1 transmitted signal vector . n0 is a N_r x 1 noise vector whose entries are i.i.d complex Gaussian variables satisfying $\mathbb{CN}(0,\sigma_0^2)$.

The time-correlated channel is represented by first order autoregressive model(AR1). The channel fading matrix can be written as

$$H_n = \alpha H_{ik}(n-1) + \sqrt{1-\alpha^2}W_{ik}(n)$$

Where H_n denotes the n-th channel fading matrix, W_n is a noise matrix, which is independent of H_{n-1} and the entries are i.i.d complex Gaussian variables with $\mathbb{CN}(0,\sigma_h^2)$. The parameter α is time correlation coefficient, which is given by the zero-order Bessel function of first kind $\alpha = J_0(2\pi f_d \tau)$ where f_d stands for the maximum Doppler frequency and τ denotes the time interval between consecutive feedback messages. τ denotes the time interval between two consecutive feedback messages.

We assume that H*ik*(*n*) is perfectly estimated by the receiver, and the feedback channels are error free but not noiseless. Thus, the output of the feedback channel can be expressed as

$$H_{ik}(n) = \overline{H}_{ik}(n) + E_{ik}(n)$$

where$\overline{H}_{ik}(n)$ denotes the quantized channel matrix with i.i.d. entries, and $E_{ik}(n)$ is the quantization error, with entries following an i.i.d. complex Gaussian distribution It can be rewritten as

$$\overline{H}_{ik}(n) = \frac{(\sigma_h^2 - \delta_d)}{\sigma_h^2 H_{ik}(n)} + \phi_{ik}(n)$$

Where $\phi_{ik}(n)$ is independent of $H_{ik}(n)$, and the entries are i.i.d complex Gaussian variables with $\mathbb{CN}(0,(\sigma_h^2-\delta_d)\delta_d/$ $\sigma h2$.

For time-correlated channels, as the previous quantization channel matrices have been known at both transmitters and receivers, the CSI can be tracked by feeding back the differential CSI, which is expressed as

$$H_{ik}(d,n) = \mathrm{Diff}(H_{ik}(n)/\overline{H}_{ik}(n-1)$$

Where $\overline{H}_{ik}(n-1)$ is the previous quantization CSI $H_{ik}(d,n)$ denotes the differential CSI at the nth block, and Diff(.) is the differential function.

A. *Channel state information distortion and minimum differential feedback rate*

Properties of communication link is denoted as channel state information. We are analyzing the relationship between the feedback rate in differential feedback scheme and quantization distortion of CSI. Using Shannon's rate distortion theory we can determine the minimum feedback rate if the CSI distortion constraint is given. The relationship between the CSI distortion and the minimum feedback rate in the differential feedback system is given by

$$N_f(i)=Nr\ Nt\ \log(\alpha_i^2+(1-\alpha_i^2)\sigma_h^2/\delta_d(i))$$

We can see that $N_f(i)$ is also a function of temporal correlation α_i in the differential feedback scheme. With high temporal correlation, the feedback rate can be significantly reduced. It can be rewritten as

$$\delta_d(i)=(1-\alpha_i^2)\sigma_h^2/\left(2^{N_f(i)/NrNt}-\alpha_i^2\right)$$

B. Interference alignment with differential feedback

For the desired signal interference alignment is an approach to maximize interference–free space . The IA schemes align the interference into a reduced-dimensional subspace and cancel it via designing transmit and receive direction vectors at the transmitter and receiver, respectively. We investigate the impact of imperfect CSI caused by the limited feedback rate on the IA scheme and derive the minimum differential feedback rate, which still preserves the maximum multiplexing gain of IA in a MIMO system. In the following derivation, we omit the block index n for convenience.

When all of the interferences are aligned into a reduced-dimensional subspace of the receiver space, a receive direction vector U_i is designed at each receiver to zero force interference. Therefore, the mth data stream at the ith receiver is given by

$$(u_i^m)^H y_i=(u_i^m)^H H_{ii}v_i^m s_i^m+\sum_{p\neq m}^{d_i}(u_i^m)^H H_{ii}v_i^p s_i^p$$
$$+\sum_{k\neq i}^{K}\sum_{p=1}^{d_i}(u_i^m)^H H_{ik}v_k^p s_k^p+(u_i^m)^H n_i$$

i=1,2,….K, m=1,2,…d_i , where u_i^m is an Nrx1 complex vector with $\|u_i^m\|^2=1$.

V. RESULT

Relation between the minimum differential feedback rate and the time correlation

In this we relate the minimum differential feedback rate and the time correlation. From figure3 we can see that the required minimum differential feedback rate for achieving the multiplexing gain can be significantly reduced as time correlation increases

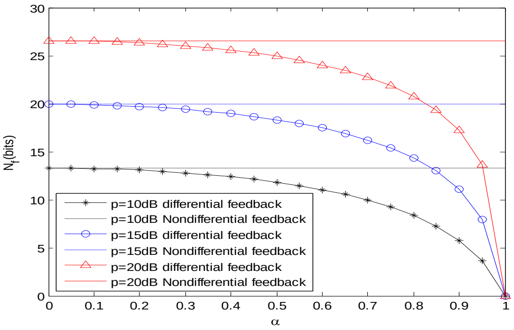

Fig.3 minimum differential feedback rate and time correlation.

Sum rate achieved by differential feedback

In this section we find out the sum rate achieved by differential feedback. In the fixed feedback rate, the performance loss increases with increase in the transmit power. From figure 4 we can see Differential feedback has the better sum rate value.

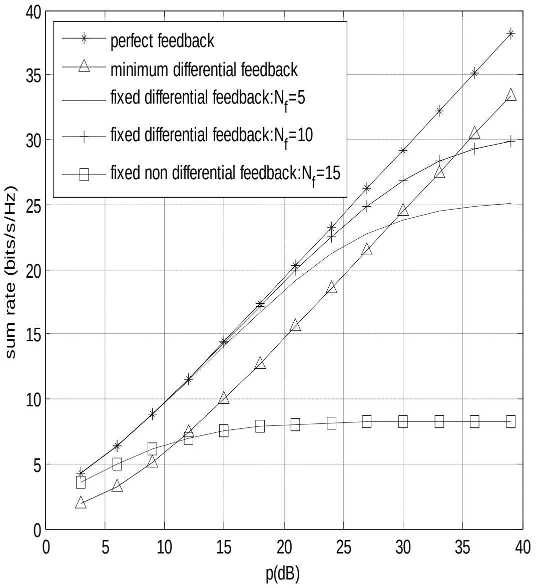

Fig.4 Sum rate achieved by differential feedback

Sum rate achieved by differential feedback using Lloyd's algorithm

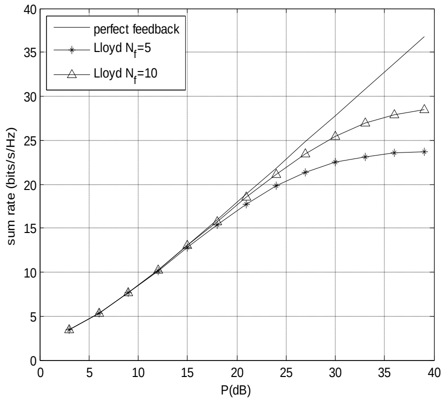

Fig.5 Sum rate achieved by differential feedback using Lloyd's algorithm

In this analysis we find out the sum rate achieved by differential feedback using Lloyd's algorithm. From fig.5 we can see Differential feedback has the better sum rate value.

VI. CONCLUSION

We have considered interference cancellation for a system with more than two users when users know each other's channels. We have proposed a system to achieve the maximum possible diversity of 16 with low complexity for 4 users each with 4 transmits antennas and one receiver with 4 receives antennas. The comparison of sum rate without Lloyd's algorithmand with Lloyd's algorithm is analyzed. By using Lloyd's algorithm in the feedback of interference alignment network the sum rate has increased because of that the SINR ratio also increased.

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