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A Low Complexity Algorithm for Receiver Antenna Selection in MIMO Systems

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Abstract: For a multiple-input multiple-output (MIMO) system with more antennas at the receiver than the transmitter, selecting the same number of receiver antennas as the number of transmitter antennas can take most of the advantages of MIMO capacity performance and at the same time reduce the system hardware cost and computational complexity. In this paper, a novel effective low complexity near-optimal antenna selection algorithms based on maximization channel capacity is proposed for the MIMO array configuration. Different from many existing fast antenna selection algorithms which obtain the sub-optimal channel sub matrix by adding or removing one row per step exploit re-computing formula, our algorithm acquires the near-optimal channel matrix by a faster updating formula. In such faster updating formula, the formula is updating rather than re-computing, so that the matrix inverse operation is avoided. Due to using an effective iteration processing, our antenna selection algorithm reduces computational complexity and leads to a substantial improvement in the capacity optimally for moderating to high signal to noise ratio (SNRs), and obtains almost the same capacity and bit error ratio (BER) performance as that of the exhaustive-search-based optimal antenna selection algorithm. Compared to the conventional sub-optimal antenna selection algorithms, our algorithm has lower computational complexity and achieves almost the same capacity and BER performance as the optimal selection algorithm. Finally, theoretical analysis and simulation results illustrate that the new algorithm outperforms the existing sub-optimal antenna selection methods.

Keywords: MIMO systems, Low complexity, Channel capacity, Receiver antenna selection.

1 Introduction

Multiple-Input-multiple-output(MIMO) wireless systems, characterized by multiple antenna elements at the transmitter and receiver, have demonstrated the potential for increasing capacity in rich multipath environments, without any increase in bandwidth or transmit power [1–3], hence it has drawn widespread attention and it is considered as the most promising technology in the future of wireless communication. This technology divides the incoming data stream into multiple data sub streams and then transmits them through different antennas to obtain high spectral efficiency. But, in order to provide high spectral efficiency, a MIMO system requires the same number of ratio frequency (RF) chains as employed antennas'; however, the cost and complexity of multiple RF chains are is a potential problem for practical implementation in a MIMO system. Antenna selection [4] that optimally chooses a subset of the available transmit and/or receive antennas is an attractive low-cost and low-complexity technique. Hence, the objective of the antenna selection scheme is to find the optimal antenna subset that can alleviate the hardware complexity and at the same time capture most of the advantages of MIMO systems. Based on the above considerations, antenna selection technique has received widespread attention recently, it is a technology that can reduce the cost of the MIMO systems and meet the require of complexity, assembles a large number of antennas between the transmitter and the receiver, uses radio frequency switch circuit to make the limited RF link assigned to the optimal antenna subset combinations for only increasing such low-cost hardware as antennas and RF switch circuit, it also could obviously improve performance of MIMO systems. To select an appropriate subset of antennas, the antenna selection algorithm of

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MIMO systems has been studied deeply in a large number of literatures for years. With the optimal antenna selection scheme [5], the RF chains can optimally connect to the best subset of transmitter and/or receiver antennas. However, the optimal antenna selection algorithm requires an exhaustive search of all candidate combinations in order to find the optimal subset at the transmitter and/or receiver, this results in a high computational complexity, it grows exponentially with increasing the total number of the antennas available, especially if the channels change rapidly and the antenna selection has to be re-evaluated frequently. The optimal antenna subset selection algorithm is an exhaustive method that computes all possible antenna subset combinations and chooses the subset of the antenna which can achieve the best system performance. While the optimal antenna selection algorithm obtains the best performance, it is hard to achieve real-time implementation because of the large complexity of the algorithm. A series of simplified antenna selection algorithms aiming at reducing computational complexity have recently been proposed. The investigation aiming at reducing computational complexity a series of simplified antenna selection algorithms is thus of great practical as well as theoretical interest. In recent years, considerable research efforts have been devoted to the developing of sub-optimal techniques [6–8] for antenna selection with well trade-offs between performance and complexity. The simplest algorithm is norm-based selection (NBS) algorithm which is proposed in [6], where the antennas corresponding to the columns of the channel matrix with the maximum Euclidean norm are selected. Compared to the exhaustive search algorithm it has lower complexity, but higher loss of channel capacity. In [7], the authors further considered the effect of channel correlation on the system performance, and proposed a correlation-based selection (CBS) algorithm which selects the antennas corresponding to the columns of the channel matrix with the maximum norm and minimum correlation. Although these tow algorithms reduce the computational complexity, yet but it leads to significant capacity loss and error-probability performance deterioration in some scenarios, especially in correlated channels. In order to reduce the computational complexity while retaining the system performance, the decremented selection (DS) algorithm was proposed in [8], the algorithm begins with choosing available antennas and then removes one antenna with the lowest contribution to the system capacity per step. Because the algorithm uses the best suitable updating algorithm, it not only achieves almost the same capacity as the optimal selection algorithm, but also reduces the computational complexity. In [9], the authors proposed a new antenna selection algorithm based on space multiplex system transmitter but didn't consider the case of receiver antenna selection.

In this paper, based on the work above, in order to reduce the computational complexity without reducing the performance of MIMO systems, we propose a new fast antenna selection algorithm approaching to the optimal performance based on maximum channel capacity, and the algorithm's core idea lies in the receivers which use efficacious iterative process to reduce the computational complexity while maintaining almost the same performance as the optimal algorithm. Compared with the DS algorithm, this new algorithm has lower computational complexity.

This paper is organized as follows. Section 2 introduces the system model. In Section 3, we derive the proposed criterion and investigate the new iterative algorithms for receive antenna selection. In Section 4, we give the computational complexity analysis about the mentioned algorithm. Simulation numerical results and corresponding discussion are provided in Section 5. Finally we draw conclusions in Section 6.

2 System model

Consider an $N_R \times N_T$ MIMO system with N_T transmit antennas and N_R receiver antennas with M ($M \leq N_R$) RF link shown in Fig.1. Based on capacity maximization criterion, we select M ($M \leq N_R$) out of N_R receiver antennas for further signal processing. Between the transmit and receive antennas is a slowly varying flat additive white Gaussian noise quasi-static Rayleigh fading channel, each group of data streams transmitted from different antennas simultaneously. When all the antennas are used for communications, the input-output relationship in MIMO systems is expressed as [10]

$$x = \sqrt{\frac{\rho}{N_T}} H_s + n, \tag{1}$$

Where $x = [x_1, x_2, \ldots, x_{N_R}]^T$ is an $N_R \times 1$ received signal vector, $s = [s_1, s_2, \ldots, s_{N_T}]^T$ is an $N_T \times 1$ transmitted signal vector, ρ is the average signal to noise ratio (SNR) at each receive antenna, $n = [n_1, n_2, \ldots, n_{N_R}]^T$ is the N_R additive Gaussian white noise with zero-mean and variance 1, and the channel matrix H is

$$H = \begin{bmatrix} h_{1,1} & h_{1,2} & \cdots & h_{1,N_T} \\ h_{2,1} & h_{2,2} & \cdots & h_{2,N_T} \\ \vdots & \vdots & \ddots & \vdots \\ h_{N_R,1} & h_{N_R,2} & \cdots & h_{N_R,N_T} \end{bmatrix}. \tag{2}$$

Where $h_{i,j}$ entry represents the channel fading coefficient between the ith receive antenna and the jth transmit antenna, which is a complex Gaussian entry of zero mean and unit variance. Accordingly the channel capacity is given by [3]

$$C = \log_2 \det \left(I_{N_R} + \frac{\rho}{N_T} H H^H \right). \tag{3}$$

Where I_n denotes the $n \times n$ identity matrix.

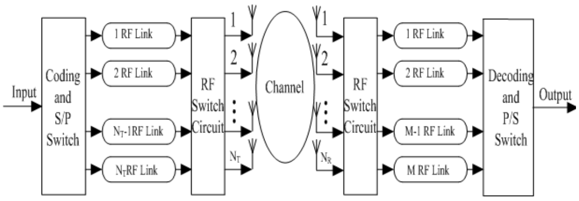

Fig. 1: Antenna Selection MIMO communication system model.

3 New receive antenna selection algorithm

To find the maximum of the channel capacity based on the optimal subset receive antenna, we consider choosing the M root of antennas' $C_{N_R}^{M}$ possible situations from N_R root of receive antennas, but the computational complexity is too high in practical MIMO communication system. In order to reduce the complexity of the MIMO system implementation, the [6–8] proposed NBS, CBS, DS and other algorithms, but the NBS and CBS algorithms have a significant loss of channel capacity. Although the DS algorithm approaches the optimal antenna selection algorithm for channel capacity, it still has a high computational complexity. Therefore, this paper will present a lower computational complexity of the antenna than the DS algorithm and can achieve the best performance of the algorithm with almost the same new receive antenna selection algorithm. At the beginning of the algorithm the sets of R receive antennas selection will set to be empty, each iteration will choose the largest contribution to the channel capacity of the receive antenna, add it to the sets of R. At the receive terminal end, as in the channel matrix H, gradually choose to make the maximum channel capacity of the M line, then add it to the antenna subset.

3.1 Analysis of receive antenna selection system capacity

Assuming that the choosing subset of a received antenna is $R = \{l_1, l_2, \ldots, l_M\}$, l_i is the choice of the ith antenna which makes the greatest contribution to channel capacity C of the receive antenna channel matrix corresponding to the row marked H, $H_{l_i}(i = 1, 2, \ldots, M)$ is the sub-matrix of channel matrix H, it consists of l_i values corresponding to H in the line by $l_1, l_2, \ldots, l_M$ in that order, that means a subset of antenna which has been selected to receive, H_{l_0} means that it had not selected any receive antenna, it also means that the antenna has been selected to receive a subset of the empty set. If h_{l_i} is the row vector H of l_ith antenna corresponding channel matrix, antenna selection has been completed the $i-1$ step, in the ith step add the remaining set of the ith antenna to the antenna subset, the antenna array matrix can be written as $H_{l_i} = [h_{l_1}^T, h_{l_2}^T, \ldots, h_{l_{i-1}}^T, h_{l_i}^T]^T = [H_{l_{i-1}}^T, h_{l_i}^T]^T$, where h_{l_i} is the ith step which add the remaining subset of the antenna towards the collection of the first antenna state vector. By equation (3) the channel capacity of receiving antenna which has not been chosen is expressed as

$$C_D = \log_2 \det \left(I_M + \frac{\rho}{N_T} H_{l_{N_R-M}} H_{l_{N_R-M}}^H \right). \tag{4}$$

Next, we focus on the contribution of selected subset of R receive antenna MIMO system to channel capacity, $H_{l_i} H_{l_i}^H$ can be written as,

$$H_{l_i} H_{l_i}^H = \begin{bmatrix} H_{l_{i-1}} H_{l_{i-1}}^H & H_{l_{i-1}} h_{l_i}^H \\ h_{l_i} H_{l_{i-1}}^H & h_{l_i} h_{l_i}^H \end{bmatrix}. \tag{5}$$

Based on (5) through (3), we can find in the ith step after a collection from the remaining antennas to the antenna insertion of a subset of $i+1$th receive antenna the channel capacity is

$$\begin{aligned} C &= \log_2 \det \left(I_M + \frac{\rho}{N_T} \begin{bmatrix} H_{l_{i-1}} H_{l_{i-1}}^H & H_{l_{i-1}} h_{l_i}^H \\ h_{l_i} H_{l_{i-1}}^H & h_{l_i} h_{l_i}^H \end{bmatrix} \right) \\ &= \log_2 \det \left\{ \begin{bmatrix} \frac{\rho}{N_T} H_{l_0} H_{l_0}^H & \frac{\rho}{N_T} H_{l_0} h_{l_1}^H \\ \frac{\rho}{N_T} h_{l_1} H_{l_0}^H & 1 + \frac{\rho}{N_T} h_{l_1} h_{l_1}^H \end{bmatrix} \right\}. \end{aligned} \tag{6}$$

Using the nature of the matrix determinant $\det \begin{bmatrix} X & Z \\ Z & W \end{bmatrix} = \det(X) \cdot \det(W - ZX^{-1}Y)$ in [11], we can make further deduced of (6) as

$$\begin{aligned} C &= \log_2 \det \left(\frac{\rho}{N_T} H_{l_0} H_{l_0}^H \right) \cdots \\ &\quad + \log_2 \det \left(1 + \frac{\rho}{N_T} h_{l_1} P_{l_1} h_{l_1}^H \right) \\ &= \log_2 \det \left(I_M + \frac{\rho}{N_T} H_{l_{N_R-M}} H_{l_{N_R-M}}^H \right) \cdots \\ &\quad + \sum_{i=1}^{M} \log_2 \det \left(1 + \frac{\rho}{N_T} h_{l_1} P_{l_1} h_{l_1}^H \right). \end{aligned} \tag{7}$$

Defining the matrix P_{l_i} as

$$P_{l_i} = I_{N_T} - H_{l_i} \left(\frac{N_T}{\rho} I_{N_R-i} + H_{l_i} H_{l_i}^H \right)^{-1} H_{l_i}^H. \tag{8}$$

Based on (4) and (7) we define the receiver antenna selection channel capacity gain as

$$\Delta C = C - C_D = \sum_{i=1}^{M} \log_2 \det \left(1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H \right). \tag{9}$$

According to (8) we can get, when ΔC is maximum the receive antenna system can be selected to maximize channel capacity. Therefore the optimal subset of antenna selection H_{l_M} can be determined by (10)

$$H_{l_M} = \arg \max_{R\{H_{l_M}\}} \Delta C. \tag{10}$$

Where $R\{H_{l_M}\}$ expresses all $(C_{N_R}^M)$ kinds of possible situation of M antenna chosen from N_R antenna, the algorithm is exhaustive search method to calculate the complex through the large hard real-time implementation. Therefore, make further derived to (10) a low computational complexity and can get approach the optimal antenna selection algorithm the channel capacity of a new receive antenna selection algorithm.

3.2 Low-complexity antenna selection algorithm

According to (9), (10) can be approximated as

$$H_{l_M} = \arg \max_{R\{H_{l_M}\}} \log_2 \det \left(1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H\right). \tag{11}$$

The above equation expresses each selection can be the channel capacity for the greatest contribution to the receive antenna. Combined with (8) and (9) we can iterate the method to determine the antenna subset selection. In each iteration we select the remaining set of receive antennas that can maximize the channel capacity to make incremental receive antenna. Assuming that without selecting the receive antenna set as $\Phi_0 = \{1, 2, \ldots, N_R\}$, antenna selection in the ith step add the l_ith antenna to antenna subset selection, after the ith step antenna selection the receive antenna set which still have not been selected is Φ_i. Therefore, the receive antenna which has been selected in the ith step can be determined by (12)

$$\begin{aligned} l_i &= \arg \max_{l \in \Phi_{i-1}} \left\{\log_2 \det \left(1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H\right)\right\} \\ &= \arg \max_{l \in \Phi_{i-1}} \left\{1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H\right\}. \end{aligned} \tag{12}$$

The selected receive antenna in the ith step is

$$l_i = \Phi_{i-1} - \Phi_i. \tag{13}$$

According to (12), l_i must be the channel matrix $H_{l_{\Phi_{i-1}}}$ after $(N_R - M)$ times replaced to get $H_{l_{\Phi_i}}$, $H_{l_{\Phi_i}}$ expresses that after the ith step antenna selection have not yet been selected to receive antenna channel matrix. In addition, in (12), $1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H$ will be double counted for $(N_R - M)$ times, to reduce the complexity of the algorithm, we must consider how to quickly update $1 + \frac{\rho}{N_T} h_{l_i} P_{l_i} h_{l_i}^H$. Choose a receive antenna from Φ_{i-1}, after add it to the subset of receive antenna

$$H_{l_{\Phi_{i-1}}} = \begin{bmatrix} H_{l_{\Phi_i}} \\ h_{l_i} \end{bmatrix} U_{l_{\Phi_{i-1}}}. \tag{14}$$

Where U is defined as unitary matrix $U_{l_{\Phi_{i-1}}} U_{l_{\Phi_{i-1}}}^H = I_{\Phi_{i-1}} = I_{N_R-(i-1)}$.

In order to find a quick update formula, we first calculate

$$G_{\Phi_{i-1}} = \left(I_{\Phi_{i-1}} + \frac{\rho}{N_T} H_{l_{\Phi_{i-1}}} H_{l_{\Phi_{i-1}}}^H\right)^{-1}. \tag{15}$$

We make the transformation to (15) as follow:

$$\begin{aligned} G_{\Phi_{i-1}} &= U_{l_{\Phi_{i-1}}}^H \begin{bmatrix} A_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^{-1} U_{l_{\Phi_{i-1}}} \\ &= U_{l_{\Phi_{i-1}}}^H \begin{bmatrix} B_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} U_{l_{\Phi_{i-1}}}. \end{aligned} \tag{16}$$

Where

$$A_{11} = I_{\Phi_i} + \frac{\rho}{N_T} H_{l_{\Phi_i}} H_{l_{\Phi_i}}^H, \tag{17}$$

$$a_{12} = \frac{\rho}{N_T} H_{l_{\Phi_i}} h_{l_i}^H, \tag{18}$$

$$a_{21} = \frac{\rho}{N_T} h_{l_i} H_{l_{\Phi_i}}^H, \tag{19}$$

$$a_{22} = 1 + \frac{\rho}{N_T} h_{l_i} h_{l_i}^H. \tag{20}$$

According to the block matrix inversion formula in [9]

$$\begin{bmatrix} A & U \\ V & D \end{bmatrix}^{-1} = \begin{bmatrix} (A - UD^{-1}V)^{-1} & -(A - UD^{-1}V)^{-1}UD^{-1} \\ -(D - VA^{-1}U)^{-1}VA^{-1} & (D - VA^{-1}U)^{-1} \end{bmatrix}.$$

We can get

$$B_{11} = (A_{11} - a_{12} a_{22}^{-1} a_{21})^{-1}, \tag{21}$$

$$b_{12} = -(A_{11} - a_{12} a_{22}^{-1} a_{21})^{-1} a_{12} a_{22}^{-1}, \tag{22}$$

$$b_{21} = -(a_{22} - a_{21} A_{11}^{-1} a_{12})^{-1} a_{21} A_{11}^{-1}, \tag{23}$$

$$b_{22} = (a_{22} - a_{21} A_{11}^{-1} a_{12})^{-1}. \tag{24}$$

Based on (17)-(20) through (24) we can get

$$b_{22} = \left(1 + \frac{\rho}{N_T} h_{l_i} P_{l_i}^H h_{l_i}^H\right)^{-1}. \tag{25}$$

According to (16) we can find that b_{22} is a diagonal element of matrix $G_{\Phi_{i-1}}$, therefore we will make a further derivation of (12) as

$$g_j = \arg\max\{diag\{G_{\Phi_{i-1}}\}\}. \tag{26}$$

Where g_j expresses the jth diagonal elements of matrix $G_{\Phi_{i-1}}$, therefore, according to (26) the corresponding antenna in ith step can be determined by (27)

$$l_i = (\Phi_{i-1})_j. \tag{27}$$

Where $(\Phi_{i-1})_j$ expresses the jth element of Φ_{i-1}. We found that though using equation (27) repeatedly, the option that can maximize the channel capacity to make incremental antenna have a series of matrix inversion, increasing the computational complexity of the algorithm. Therefore, we need to study how to inverse matrix recursion quickly. According to the matrix inversion formula $(A-UD^{-1}V)^{-1} = A^{-1}+A^{-1}U(D-VA^{-1}U)^{-1}VA^{-1}$ in [6], combine the (21)-(24), we have

$$\begin{aligned} B_{11} &= A_{11}^{-1}+A_{11}^{-1}a_{12}(a_{22}-a_{21}A_{11}^{-1}a_{12})^{-1}a_{21}A_{11}^{-1} \\ &= A_{11}^{-1}+b_{12}b_{22}b_{21}. \end{aligned} \tag{28}$$

Combine (17)-(20) and (28) we can get the G_{Φ_i}

$$G_{\Phi_i} = A_{11}^{-1} = B_{11}-b_{11}b_{22}b_{21}. \tag{29}$$

Therefore, when we assuming that $G_{\Phi_0} = (I_{N_R}+\frac{\rho}{N_T}H_{I_{N_R}}H_{I_{N_R}}^H)^{-1}$ is known, according to equation (13), (26), (27) and (29) we can get the fast receive antenna selection algorithm. Summarize the above derivation process, receive antenna selection algorithm is described as following.

1) At the beginning: define the index set of the antennas not selected, assume that $\Phi_0 = \{1,2,\ldots,N_R\}$, $R=\varnothing$. Calculate $G_{\Phi_0} = (I_{N_R}+\frac{\rho}{N_T}H_{I_{N_R}}H_{I_{N_R}}^H)^{-1}$ according to all $p \in S_R$, select antenna P meet $g_j = \arg\max\{diag\{G_{\Phi_{i-1}}\}\}$.

2) Assuming $n=2$, when $2 \le n \le M$, $R = R\cup\{P\}$, $\Phi = \Phi-\{P\}$, for all $p \in S_R$.

①Using the equations (13), (26), (27) updating $G_{\Phi_i} = A_{11}^{-1} = B_{11}-b_{12}b_{22}b_{21}$, take $i=n+1$, calculating $g_j = \arg\max\{diag\{G_{\Phi_{i-1}}\}\}$, choosing the antenna p.

②Updating the set Φ_i, R and $H_{I_{\Phi_i}}$.

When $n>M$, stop the cycle, return to the set R.

4 Algorithms complexity analysis

In this section we give the computational complexity analysis about the mentioned algorithm, in step 1 G_{Φ_0} computational complexity is $(N_R^3+N_R^2)/4+N_R^2N_T$, in step 2 choose M receive antennas, the computational complexity mainly concentrates on the update of matrix $G_{\Phi_i} = A_{11}^{-1} = B_{11}-b_{12}b_{22}b_{21}$, the computational complexity is $(M^3-M)/3$. So this algorithm's computational complexity is $(N_R^3+N_R^2)/4+N_R^2N_T+(M^3-M)/3$. At the same time, compared with traditional DS algorithm, we found that the algorithm mentioned in this paper has a lower computational complexity, because the computational complexity of DS algorithm in [5] is

$$CMS = (N_T-M/2)N_R^2M+\cdots \left(\begin{array}{c} N_R^3+12N_R^2N_T+4N_RN_TM-\cdots \\ 6N_R^2M-2N_RM^2+N_R^2+2N_RM \end{array}\right)/4. \tag{30}$$

In order to compare these two algorithms more intuitively, we used $(N_R^3+N_R^2)/4+N_R^2N_T+(M^3-M)/3$ in Matlab and the curve of describing computational complexity and selecting the number of antenna is shown in Fig.2

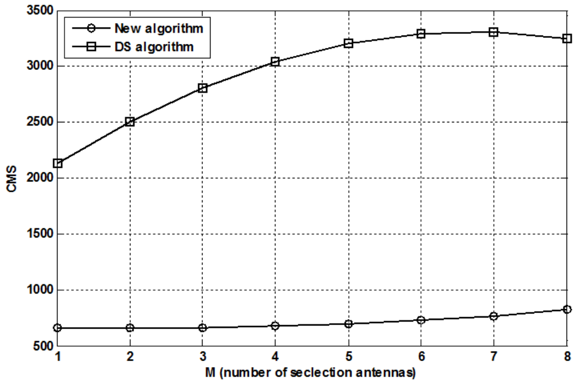

Fig. 2: The complexity multiplications for antenna section versus the number of selection antenna M when the number of receiver and antenna respectively are fixed at $N_R = N_T = 8$.

Where we assumed the number of receive and transmit antennas respectively are $N_R = N_T = 8$. Compare with traditional algorithm DS, this algorithm has a much lower computational complexity because of the use of faster update iterative which uses update expression instead of repeated computation to avoid a lot of inverse matrix.

5 Simulation results analysis and discussion

In following section we compare with the performance of the optimal selection algorithm, DS, CBS, NBS, random antenna selection algorithm to the proposed algorithm by computer simulation software (Matlab). We assumed the number of receive and transmit antennas respectively are $N_R = N_T = 8$, under the prospective static Rayleigh fading channel, the transmit terminal uses QPSK modulation technology and the receiver uses the least mean square error(MMSE), each simulation result is obtained by averaging over 10000 channel realizations.

To prove that the proposed algorithm has lower computational complexity and the performance close to optimal antenna selection, the comparison of channel capacity and bit error rate is proposed between the new suggested algorithm and other algorithms in prospective Rayleigh fading channel. Fig.3 and Fig.4 are respectively the curves of channel capacity and bit error rate changing with SNR when receiver selecting the antenna is $M=4$. As the result shows, in the prospective static Rayleigh fading channel, the new proposed algorithm compared with CBS, NBS, random antenna selection algorithm, can provide obvious channel capacity performance gain and bit error rate performance gain, and almost has the same performance of optimal antenna selection algorithm and DS algorithm. The main reason for this is that the new proposed algorithm takes the norm among the corresponding channel matrix row vector of the chosen receiving antenna into consideration.

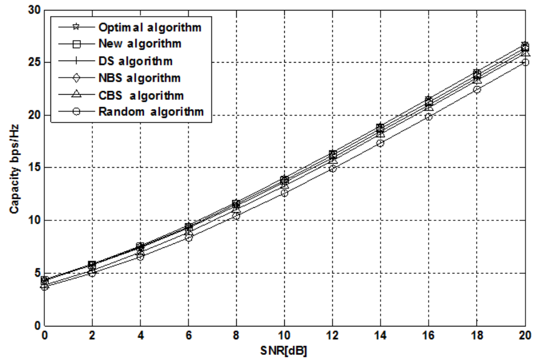

Fig. 3: Capacity versus SNR curves of all algorithms in i.i.d. fading channel.

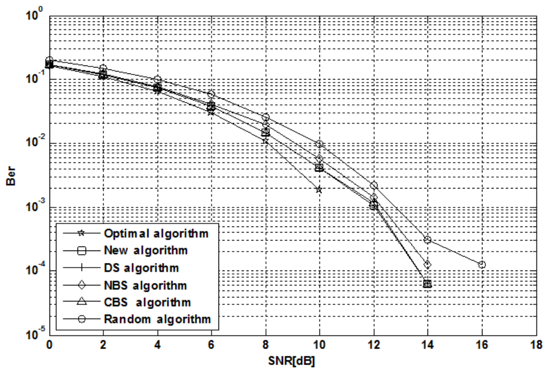

Fig. 4: BER versus SNR curves of all algorithms in i.i.d. fading channel.

The above section is just a comparison of all antenna selection algorithms performance of which pre-established the number of antenna is M. In order to study the number of receiver antenna impact on system performance, Fig.5 and Fig.6 are respectively the curves of channel capacity and bit error rate changes with antenna selection number M when $SNR = 14dB$. The simulation results show that, in the prospective static Rayleigh fading channel, the new proposed algorithm can get almost the same performance of optimal antenna

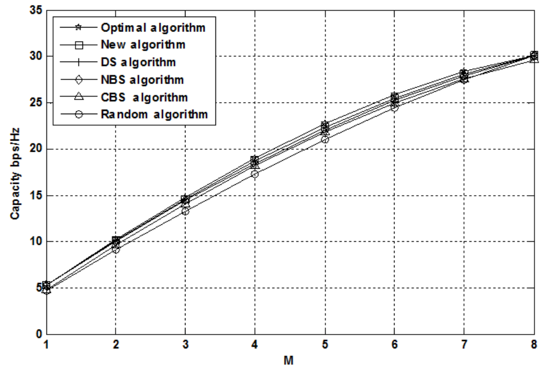

Fig. 5: Capacity versus M curves of all algorithms in i.i.d. fading channel.

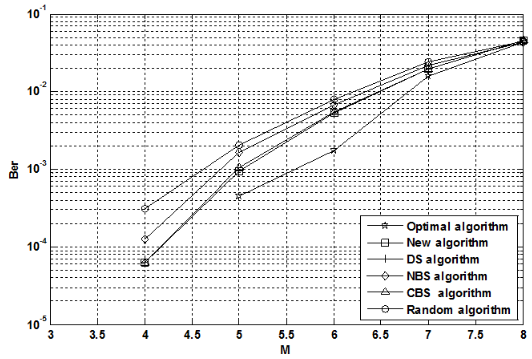

Fig. 6: BER versus M curves of all algorithms in i.i.d. fading channel.

selection algorithm and DS algorithm, and such performance is obviously better than that of NBS, CBS and random antenna selection algorithm. Besides, from the simulation results we can clearly see that all antenna selection algorithms' capacity increase with the receive antenna selection number $M = 4$ while bit error rate decreases. Because of in the practice, the multiplexing gain of system increases with the chosen antenna number while diversity dimension decreases [12], so we have to choose the antenna number properly according to the actual condition and system performance demanded.

6 Conclusion

In MIMO system, receiving antenna selection is a simple but effective technology to improve system performance. This paper based on the analysis of channel capacity formula and matrix reverse formula proposed an algorithm that can quickly realize the receiving antenna selection algorithms. The new algorithm compared with DS algorithm, has a lower computational complexity because of the using of rapid iteration update formula. At the same time, it can achieve almost the same capacity and BER performance as the optimal selection algorithm. Especially in the prospective static Raleigh fading channel, such performance is obviously better than that of NBS, CBS and random antenna selection algorithm. Finally, the new algorithm performance is proved by computer simulation.

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