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"Low Complexity Antenna Selection Technique for Mimo System"

KEYWORDS

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ABSTRACT *In this paper we had simulated sub optimal antenna selection techniques for 2X2 and 4X4 MIMO system and it will provide a possibility of substantial gain increase through increasing and decreasing order by ascending or descending selection strategies with respect to antennas. It was observed that the 2X2 MIMO system at low SNR high capacity of about 2.32dB for antenna 1 and the maximum capacity of about 11.34dB is obtain at 20dB SNR. For 4X4 MIMO system selection of only two antennas is required. As compare to traditional optimal antenna selection the complexity is reduces by selecting the sub set of antennas.*

1 INTRODUCTION

MIMO systems can improve the capacity and reliability of radio communication. However, the multiple RF chains associated with multiple antennas are costly in terms of size, power, and hardware [1].

The antenna selection is a low-cost, low-complexity alternative to capture many of advantages of MIMO systems [2]. It can reduce hardware complexity and cost, achieve full diversity and, in the case of transmit antenna selection, achieve capacity [3]. The MIMO signaling can improve wireless communication in two different ways as we showed previously; diversity methods and spatial multiplexing, which are again dependent upon the antenna selection. Thus, it is called antenna selection diversity. The selection diversity approach selects the antenna with the highest received signal power, mitigating fading .it is the simplest technique to implement and requires only one RF chain. There are two main approaches to antenna selection: Norm-based selection approaches and Successive selection [4].

The Norm based approach is more suitable when the SNR is low, whereas the successive selection suits the high SNR regime .Both methods can be applied for either transmit or receive antenna selection[4]. Nevertheless, norm-based selection may be used because of its low computational complexity, antenna selection, achieve capacity [5]. As per the previous work that involve too much complexity depending on the total number of available antennas [6]. Now in the present work in order to reduce the complexity we resort to suboptimal Antenna Selection method applied to MIMO system.

II SYSTEM MODEL

This section reviews antenna selection methods that capture diversity and improve the SNR of the system. Diversity refers to the existence of two or more signal paths that fade independently. This happens when the radio channel consists of several paths that are sufficiently separated in space, time, frequency, or (sometimes) polarization. The key idea is that if several paths have channel coefficients that are statistically independent, it is unlikely that they will fade together, so the probability is small that signal strengths will fall below detection threshold [6].

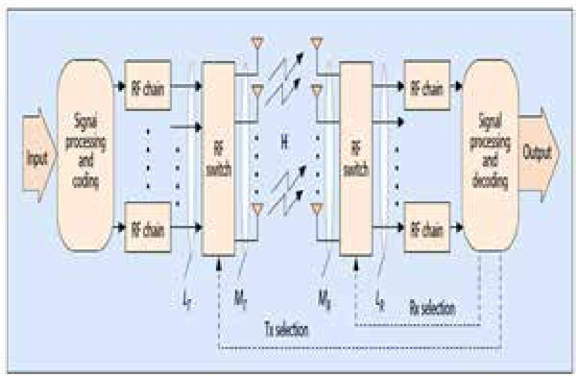

Figure 1: Antenna selection in MIMO system

The system under consideration is MIMO system employing *Mt* transmit antennas and *Mr* receive antennas, as illustrated in Fig. 1. In the proposed system only 'L' RF modules are used to support transmit antennas(L<). The the received signal y is represented by equation (1).

$$y = \sqrt{\frac{E_X}{L}} H_{\{p_1,p2,p3...pL\}}{}^{X+Z} \quad (1)$$

Where, the effective channel can now be represented by L columns of H, Denote the index of the ith selected column, i= 1,2,3,4,......,L. Then, the corresponding effective channel will be modeled by matrix ,which is denoted by, X denote the space time coded (STC) or spatial multiplexed stream that is mapped into 'L' selected antennas, is additive noise vector. The channel capacity of the system in Equation (1) will depend on which transmit antennas are chosen as well as the number of transmit antennas that are chosen [7, 8].

III SUB-OPTIMAL ANTENNA SELECTION SCHEME

In order to reduce its complexity [6] we resorted the selection parameter into sub-optimal method. For example, additional antenna can be selected in ascending order of increasing the channel capacity. More specifically, one an-

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tenna with the highest capacity is first selected the selection process is as follows.

$$p_1^{subopt} = \arg\max_{p1} C_{\{p1\}} \arg\max_{p1} log2\ det(IM_R + \frac{E_X}{QN_O} H_{\{$$

(2)

After the nth iteration which provides ,the capacity with an additional antenna, say antenna l,can be updated as

$$C_1 = \log_2 det\{I_{M_R+} \frac{E_X}{QN_o} (H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} H^H_{\{p_1^{subpot} \ldots p_n^{subpot}} + H_{\{l\}} H^H_{\{l\}})\}$$

$$= \log_2 det\{I_{M_R+} \frac{E_X}{QN_o} (H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} H^H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} + \log_2\{1 + \frac{E_X}{QN_o} H_{\{l\}} (I_{M_R+} \frac{E_X}{QN_o} H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} H^H_{\{p_1^{subpot} \ldots p_n^{subpot}\}}))$$

(3)

The addition (n+1)th antenna is the one that maximizes the channel capacity in equation (3),that is,

$$p_{n+1}^{subopt} = \arg\max_{l \in \{p_1^{subopt}, \ldots, p_1^{subopt}\}} C1$$

$$= \arg\max_{l \in \{p_1^{subopt}, \ldots, p_1^{subopt}\}} H_{\{l\}} \{I_{M_R} \frac{E_X}{QN_o} (H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} H^H_{\{p_1^{subpot} \ldots p_n^{subpot}\}} + H_{\{l\}} H^H_{\{l\}})\}$$

(4)

This process continues until all 'L' antennas are selected (i.e. continue the iteration equation (4) until n+1=L). Note that only one matrix inversion is required for all }in the course of the selection process. Mean while, the same process can be implemented by deleting the antenna in descending order of decreasing channel capacity. Let denotes set of antenna indices in the nth iteration . In the initial step,we consider all antennas,.......,selected the antenna that contributes least to the capacity, that is,

$$p_1^{deleted} = \arg\max_{p_{1 \in s_1}} log_2\ det(I_{M_R + \frac{E_X}{QN_o} H_{s_1\{p1\}} H^H_{s1}} \{p1\})$$

(5)

The antenna selected from equation (5) will be deleted from the antenna index set, and the remaining antenna set is updated to .If |, we choose another antenna to delete .This will be the one that constributes least to the capacity now for the current antenna index set that is,

$$p_2^{deleted} = \arg\max_{p2 \in s2} \frac{log_{det(I_{M_R + \frac{E_X}{QN_o} H_{s_2\{p2\}} H^H_{s2}} \{p2\})}}{L}$$

(6)

Again, the remaining antenna index set is updated to By considering the performance of sub-optimal selection method, which selects the antenna subset and maximizing the channel capacity.

IV RESULT AND DISCUSION

Figure 2 illustrate plot of capacity based sub-optimal antenna selection technique of 2X2 MIMO system for different SNR (i.e 0 to 20dB), it has been observed that up to 0dB antenna will shows better capacity when the SNR increases

SNR (dB)	MIMO System					
	2X2 MIMO Capacity (bps)		4X4 MIMO Capacity(bps)			
	M_{T1}	M_{T2}	M_{T1}	M_{T2}	M_{T3}	M_{T4}
0	1.83	1.70	2.78	3.46	3.53	3.35
2	2.32	2.28	3.37	4.42	4.64	4.48
4	2.86	2.96	3.98	5.48	5.92	5.81
6	3.44	3.74	4.61	6.62	7.38	7.35
8	4.05	4.62	5.25	7.83	8.97	9.06
10	4.68	5.58	5.90	9.07	10.67	10.94
12	5.32	6.63	6.55	10.35	12.47	12.97
14	5.97	7.73	7.21	11.64	14.32	15.12
16	6.62	8.89	7.87	12.95	16.23	17.37
18	7.28	10.10	8.53	14.26	18.16	19.71
20	7.94	11.34	9.20	15.58	20.11	22.12

channel capacity is high for antenna 2, the various capacity (bps) for antenna 1 and antenna 2 is shown in table

Table.1: Capacity of 2X2 and 4X4 MIMO System with sub-optimal Antenna Selection at different SNR in increasing order transmit antenna Selection

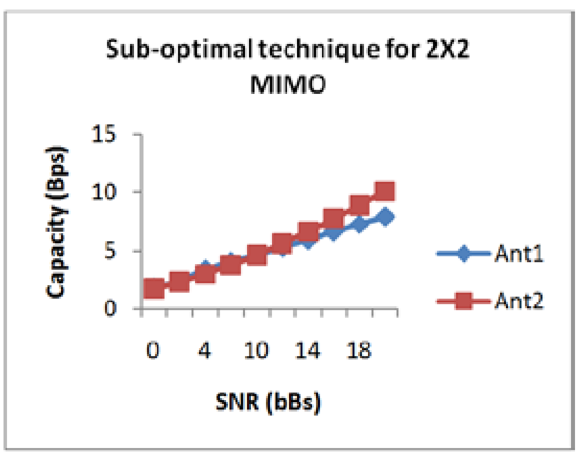

Fig: 2 Capacity based Sub-optimal technique selection for 2X2 MIMO

Figure 3 illustrate the plot of capacity based sub-optimal antenna selection of 4X4 MIMO system for different SNR, the selection of antenna 3 is enough for below 6dB and also observed that when SNR is above 6dB the selection of antenna 4 is enough to authorized the channel capacity and the various capacity for different antennas at differ-

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ent SNR are shown in table1. From the table 1 it is clear that at 0dB the highest capacity is 1.83bps for antenna 1 in 2X2 MIMO and that of 3.53bps for antenna 3 in 4X4 MIMO this indicates that the number of antennas increases the capacity is increases.

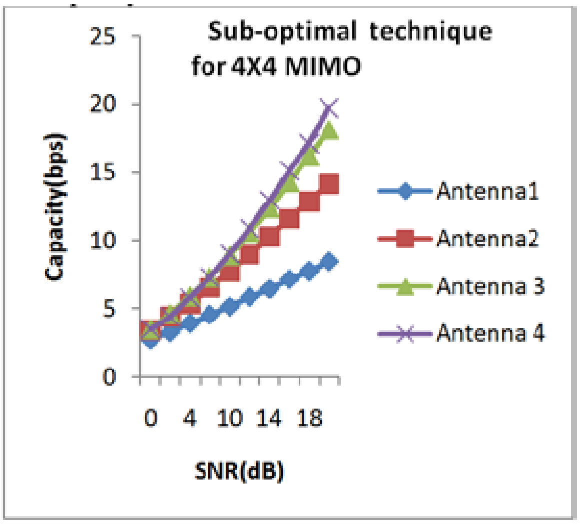

Fig:3. Capacity based Sub-optimal antenna selection for 4X4 MIMO

Conclusion

We had simulated optimal antenna selection techniques for 2X2 and 4X4 MIMO system and it will provide a possibility of substantial gain increase through increasing and decreasing order by ascending or descending selection strategies with respect to antennas. It was observed that the 2X2 MIMO system at low SNR high capacity of about 2.32dB for antenna 1 and the maximum capacity of about 11.34dB is obtain at 20dB SNR. For 4X4 MIMO system selection of only two antennas is required. As compare to traditional optimal antenna selection the complexity is reduces by selecting the sub set of antennas.

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