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RESEARCH ARTICLE

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TRANSMIT ANTENNA SELECTION OF MIMO SYSTEMS TO IMPROVE ENERGY EFFICIENCY

ANCY V*[1],.DANYA MERCLINE T[2], Dr.SREEJA MOLE S.S[3]

[1]PG student, ECE Department, Narayanaguru college of engineering, Manjalumoodu, Tamilnadu, Kanyakumari District, India

[2]Assistant professor, ECE Department, Narayanaguru college of engineering, Manjalumoodu, Tamilnadu, Kanyakumari District, India

[3]Head of the Department, Narayanaguru college of engineering, Manjalumoodu, Tamilnadu, Kanyakumari District, India

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ANCY V

ABSTRACT

Transmit antenna selection is proposed to improve the energy efficiency of large scale multiple antenna systems. A good approximation of the distribution of the mutual information is derived in this transmit antenna systems. Channel hardening phenomenon is retained as full complexity with antenna selection. A close-form expression is used to assess the energy efficiency performance. The energy efficiency is evaluated in two different cases. First energy efficiency is computed by considering the circuit power consumption which dominates the transmit power and secondly the circuit power is ignored due to high transmit power. The theoretical analysis indicates that there exists optimal number of selected antennas to maximize the energy efficiency in first case whereas in second case the energy efficiency can be increased when all the available antennas are used. Based on these concepts two antenna selection algorithms are proposed to obtain maximum energy efficiency.

Key word – transmit antenna selection, channel hardening, energy efficiency, selection algorithms.

INTRODUCTION

Energy efficiency is the main problem in power limited applications [1]-[2]. The growing energy demand and increasing energy price has been noticed in the future mobile cellular systems[3]. Now-a-days multiple antennas are used in wireless communication systems to reduce the power consumption and also to reduce the transmit power. Simple signal detectors are introduced to reduce the computational complexity in multiple antenna systems [4]-[5]. Multiple antennas require multiple RF chains which consist of amplifiers, analog to digital converters, mixers, etc. One of the disadvantages of employing multiple antennas is its associated complexity results from employing a separate radio frequency (RF) chain for every

employed antenna. This increases the implementation cost. To reduce the cost of Multiple Input Multiple Output (MIMO) system reduced number of RF chains must be used. For that purpose antenna selection is employed which selects the efficient antenna from either transmitter side or receiver side. Several algorithms are proposed for selecting the antennas. In [6] it is proposed to select the subset of transmit or receive antennas based on the maximum mutual information criterion. Antenna selection algorithm that minimizes the bit error rate (BER) is presented in [7].

In large scale multiple antenna systems antenna selection is to be employed which reduce the usage of multiple RF chain because it introduces complexity burdens. Most of the energy efficient systems focus on minimizing the transmit power only, which is reasonable when the transmit power is large enough and number of used RF chains is less. But, when the transmit power is small and power consumption dominates the transmit power the large scale multiple antenna system outperform the systems with less antennas in energy efficiency. With these problems stated above antenna selection is employed to reduce the hardware complexity and still retaining the diversity order [8]. Theoretical studies in [9] and [10] show that the diversity order achieved through antenna selection is same as that of the systems using whole set of antennas which motivates the use of antenna selection. The transmit and receive antenna system is shown in figure 1.

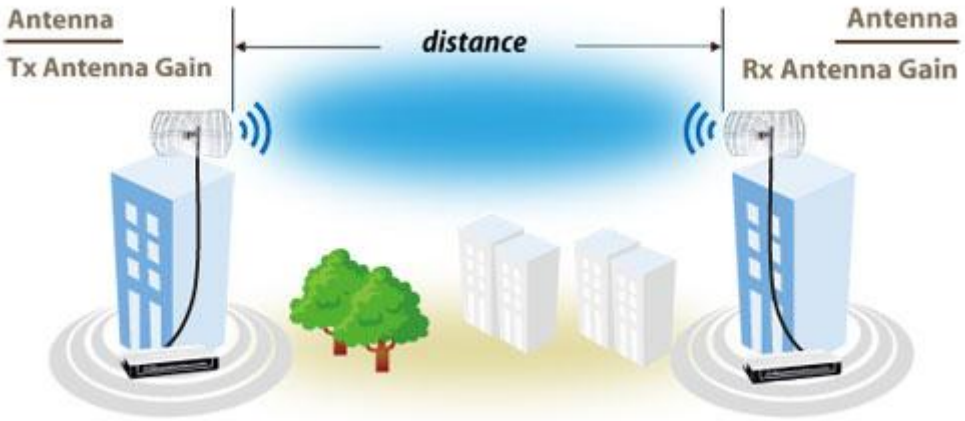

Figure 1: Transmit and receive antenna system

In this paper we focus on transmit antenna selection with large number of available antennas at the receiver. Under this scenario we derive a good approximation of mutual information with selecting any number of antennas. With large number of available antenna at the receiver an asymptotic distribution of the mutual information in [9] is obtained as the special case when numbers of selected antennas equals to the number of total available transmit antennas. The power consumption is considered as the addition of transmit power and the circuit power consumption. When circuit power consumption dominates or equals the power consumption, an optimal number of elected antennas is obtained and more used antennas can reduce the energy efficiency. Based on these concepts some antenna selection algorithms are proposed and best antenna selection algorithm is selected to improve the energy efficiency.

FAST ANTENNA SUBSET SELECTION ALGORITHM

Fast antenna subset selection algorithm finds a near optimal selection of receive antenna based on capacity maximization. This algorithm begins with full set of antennas available and then it removes antenna per step. In each step the antenna with lowest contribution to the system capacity is removed. This process is repeated until the required number of antennas remain.

DISCRETE STOCHASTIC APPROXIMATION ALGORITHM

Discrete stochastic approximation algorithm select better antenna subset using criteria such as maximal mutual information, bounds on error rate etc. this algorithm is used to reduce the error rate. This optimization algorithm selects antenna based on four objective functions. They are MIMO mutual information, bounds on error rate, SNR, and error rate.

PROPOSED METHOD

In large scale multiple antenna system energy efficiency is increased by transmit antenna selection. Among multiple antennas at the transmitter side efficient antenna is selected using antenna selection algorithm. Two antenna selection algorithms are proposed and its performance is computed. The overview of the transmit antenna selection is shown in fig.1. In system model the channel condition is verified and efficiency is computed. Two selection algorithms are proposed to select the efficient antenna and energy efficiency is computed.

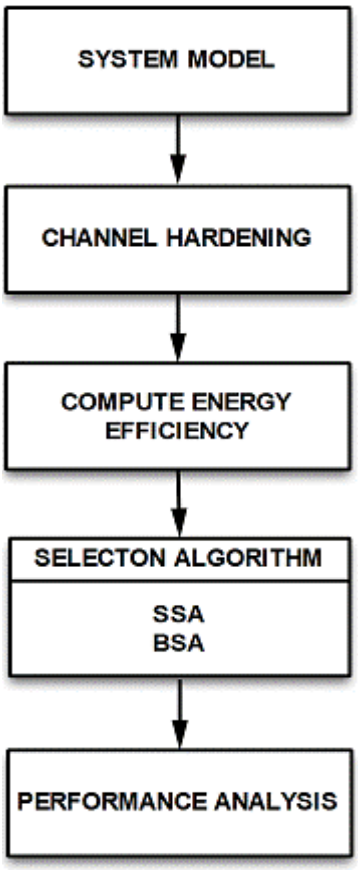

Figure 1: overview of transmit antenna selection

In system model the base station is equipped with N antennas and user has M antennas. If N>>M the received signal is shown in fig.2. The channel conditions are verified and mutual information is transformed among the antennas. Then energy efficiency is computed and antennas with better efficiency are selected using antenna selection algorithm and based on this efficient antennas are selected.

SELECTION ALGORITHM

In large scale multiple antenna systems for transmit antenna selection it is assumed that the number of available RF chain is fixed and the problem is focused on how to select the optimal antenna subset efficiently. Based on this two antenna selection algorithm are proposed.

A. Sequential search algorithm.
B. Binary search algorithm.

A. SEGUENTIAL SEARCH ALGORITHM

In sequential search algorithm first optimal antenna subset is obtained and antenna with best channel condition is selected and RF chain is employed to that selected antennas. If the element in antenna subset is greater than number of RF chains then the algorithm terminates. In this algorithm the energy efficiency increases first and then decreases as the number of selected antennas increases.

B. BINARY SEARCH ALGORITHM

Binary search algorithm selects the antenna based on specified sorted array i.e. it select the antenna which has high efficiency and compare these antenna array with the other antennas in the optimal antenna subset. The antenna array which has nearer efficiency with the first selected antenna is then selected and RF chain is employed to that selected antennas.

Transmit antenna selection is performed to select the best antenna among the all available antennas in the base station. The two proposed antenna selection scheme performs this antenna selection and considers the number of selected antennas and antenna subset which maximizes the energy efficiency.

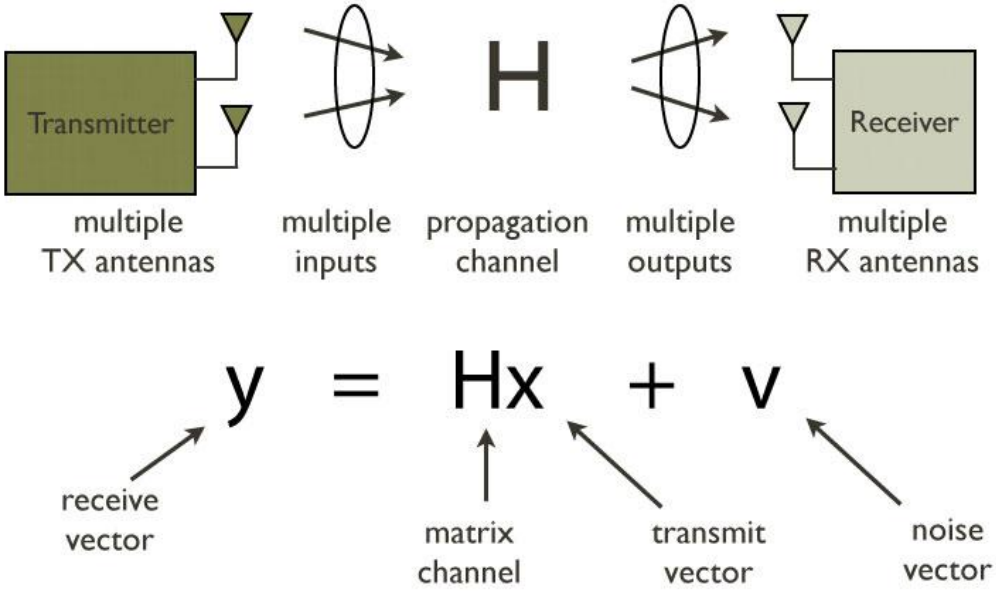

Figure 2 System Model

CONCLUSION

In this paper different antenna selection schemes for transmit antenna selection are discussed. Among these antenna selection scheme sequential search algorithm and binary search algorithm are used in the proposed system which adaptively selects the number of used antennas and improve the energy efficiency. The good approximation of mutual information is achieved with this antenna selection. Also we find that if the circuit power is too larger than the transmit power then using too many antennas will reduce the energy efficiency. Thus we can conclude that the proposed antenna selection schemes can increase the energy efficiency significantly.

REFERENCES

[1]. K. Lahiri, A. Ragunathan, and S. Dey, "Efficient power profiling for battery-driven embedded system design", IEEE Trans. Comput.-aided design integr. Circuits syst., vol.23, no. 6, june 2004.

[2]. K. Lahiri, A. Ragunathan, S. Dey and D. Panigrahi," Battery-driven system design: a new frontier in low power design," in proc. 2002 Intl.conf. on VLSI Design.

[3]. L. song and J. shen, Evolved cellular network planning and optimization for UMTS and LTE CRC press 2010.

[4]. L. Song and A.G Burr,"successive interference cancelation for space-time block codes over time-selective channels," IEEE commun. Let., vol. 10 no. 12 pp. 837-839, Dec.2006.

[5]. L .Song R.C Lamare, and A.G Burr, "successive interference cancellation for time-reversal space-time block codes," IEEE Trans veh. Tehnol., Vol.57, no. 1, pp. 642-648, jan. 2008.

[6]. R. Nabar,D. Gore, and A. Paulraj, "Optimal selection and use of transmit antennas in wireless systems," in Proc. Int. Conf. Telecommun. (ICT), Acapulco, Mexico, May 2000.

[7]. R. Heath and A. Paulraj, "Antenna selection for spatial multiplexing systems based on minimum error rate," in Proc. IEEE Int. Conf. Commun. (ICC), Helsinki, Finland, Jun. 2001.

[8]. H. Li, L.Song, D. Zhu, and M. Lei, "energy efficiency of large scale MIMO systems with transmit antenna selection," in 2013 ICC.

[9]. B. M. Hochwald, T. L. Marzetta, and V. Tarokh, "Multiple antenna channel-hardening and its implication for rate feedback and scheduling" IEEE Trans. Inf. Theory, Vol. 50, no. 9, pp. 1893-1909, Sep.2004.

[10]. Inaki Berenguer, Xiaodong wang, and Vikram Krishnamurthy,"Adaptive MIMO antenna selection via discrete stochastic optimization" IEEE Trans. on signal processing, Vol. 53, no. 11, Nov 2005.

[11]. Mohammad Gharavi-Alkhansari, Member, IEEE, and Alex B. Gershman, Senior Member, IEEE, "Fast Antenna Subset Selection in MIMO Systems" IEEE trans on signal processing, vol. 52, no. 2, february 2004.

[12]. A. F. Molisch, M. Z. Win, and J. H. Winters, "Capacity of MIMO systems with antenna selection," in Proc. IEEE Int. Conf. Communication (ICC), Helsinki, Finland, Jun. 2001.

[13]. Hien Quoc Ngo, Erik G. Larsson, and Thomas L. Marzetta" Energy and Spectral Efficiency of Very Large Multiuser MIMO Systems"submitted to the ieee transactions on communications.

[14]. S. L. Loyka, "Channel capacity of MIMO architecture using the exponential correlation matrix," IEEE Commun. Lett., vol. 5, no. 9, Sep. 2001.

[15]. S. Sanayei and A. Nosratinia, "Antenna selection in MIMO systems," IEEE Commun. Mag., Oct. 2004.

[16]. X. Zhang, F. Chen, and W. B. Wang, "Outage probability study of multiuser diversity in MIMO transmit antenna selection systems," IEEE Signal Process. Lett., vol. 14, no. 3, Mar. 2007.

[17]. Chen, J. Yuan, and B. Vucetic, "Analysis of transmit antenna selection/maximal-ratio combining in rayleigh fading channels," IEEE Trans. Veh. Technol., vol. 54, no. 4, July 2005.