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A Survey of User Selection and Sum Rate Maximization

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Abstract:*A cellular network is a communication network.Sumrate maximization is an important factor associated with cellular communication. Basically in cellular communication systems downlink is modelled as broadcast channel which includes one base station and several users, where the base station can transmit data to many user. Lots of resource allocation policies are available to achieve maximum sum rate in broadcast channel.This paper includes different techniques and summaries about the sum rate maximization. The major problem in cellular communication system is the active user selection. Selecting active users among many users is a complex optimization problem.*

Key Words*: User selection,Sumratemaximization,MIMO, MIMO-BC*

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I. Introduction

Wireless communication systems are used to transmit data through a wireless medium over long or short distances. Basically telecommunication systems includes different techniques that are fixed, mobile, and portable two way radios. The most advanced and efficient wireless technologies are Global Positioning System(GPS),satellite television and cordless telephones. In conventional wireless communication systems single antennas are used at both transmit and receive sections. In many cases some critical issues will created due to the single antenna usage at both transmit and receive antennas. To avoid the issues due to the single antenna usage new technology developed is Multiple Input and Multiple Output(MIMO),where multiple number of antennas are present in both transmit and receive section. MIMO is one of the good form of smart antenna technologies, other technologies are MISO(Multiple Input Single Output),SIMO (Single Input Multiple Output). Basically MIMO systems are used to obtain very high data rate over wireless network. Most of the resource allocation policies are used for maximize the achievable sumrate over communication systems. Most commonresource used in communication systems is Power. Power allocation plays an important role in data transmission over wireless networks. Here can introduce Multiple Access Channel(MAC) and MAC-BC Duality theory[2] in order to improve the sum rate. Normally MAC are used for transmit data through more than two terminals which is connected to the same transmission path to improve the system capacity. From several studies obtained a valid result that the Gaussian MAC and BC are duels of each other and provides capacity region of the Broadcast channel and Multiple Access Channel. While considering the Broadcast channel there will only has a single power constraint on every transmitter section. According to" MAC-BC Duality theory"there exists the MAC-BC conversion between the resource distributions in MAC and BC such that the maximumattainable rate tuples are the same while the total power is conserved. Here the Multi output BC can be solved by using iterative water filling technique. Users power allocation changes will affects the interference towards the others in order to avoid this issue the users need to iteratively update their own powers, this effect is called iterative water filling[15]. Consider another optimization problem which is called sum rate maximization problem due to user selection. Here can predict that sum rate of a communication system can be improved by selecting active users[1].

II. Literature Review

Multiple Input Multiple Output systems have already evidenced its capability to attain high data rate over various different transmission paths. MIMO BC includes base station with number of multiple antennas which are connects with many users. The important term that associated with the sum rate maximization is multi user diversity gain which says that when hugenumberofusers are available on a communication network ,then the base station canincrease the sumrate by choosing best user subset. According to the studies in recent years there has been excessiveattention in capacity region calculations. Calculating the capacity of Multiple Input Multiple Output broadcast channels, is a key problem due to the absence of a theoretical concept on non-degradedtransmissions. By applying the "dirty paper"coding at the transmitter side can achieve set of

attainablesumrate in MIMO BC . The sum rate Multiple Input Multiple Output Broadcast Channel capacity equals the maximum sum rate of this attainable region for the two-user BC with an random number of transmit antennas and one receive antenna at each receiver. Due to thenon-degraded nature of broadcast channel it is tough to achieve the complete capacity region. System models of the MIMO BC and the MIMO MAC channels is given fig1.Next derive a MAC BC conversion that picks a set of MAC covariance matrices as input and with a decoding order and a set of BC covariance's as output with the same sum power as the MAC covariance's that attains rates equals to the rates attained in the Multiple Access Channel by using the Multiple Access Channel covariance matrices and decoding procedure which includes the quantified decoding order. Next derive a transformation depends on the BC covariance matrices and encoding procedure with encoding order, outputs a set of MAC covariance's with the same sum power as the BC covariance's that attain MAC rates equal to the rates attained in the BC using the BC covariance matrices[2].

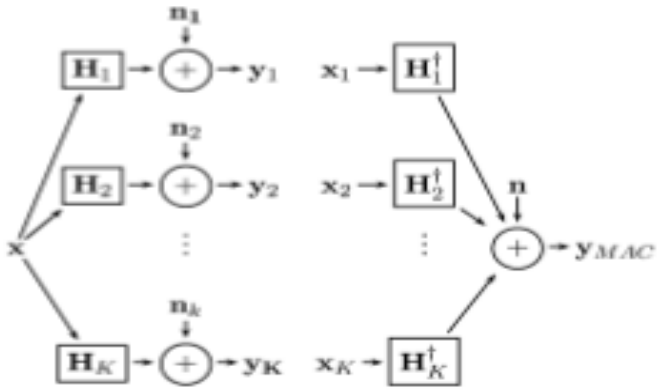

Fig.no.1. Representation of MIMO BC (left) and MIMO MAC (right) channels[2]

The another important section of a sum rate maximization is the dirty paper coding. Basically the DPC(Dirty Paper Coding)is associated with information theory, which helps to transmit data to the receiver with full protection. Here have different dirty paper techniques that are " sum code based dirty paper coding scheme" ,"construct code word in binary domain" and map them into a signal constellation. The dirty paper coding includes both encoding and decoding procedure. The DPC scheme will not be practical for many codes. Next important concept related to the DPC scheme is Sum code based DPC schemes using convolutional codes. For constructing such kind of schemes we have to create a scenario where needs transmitted base information over "L" uses of a real channel and interference sequences[6]. The constrained decoder takes the form of a constrained decode in the case of sum codes based on convolutional codes,"r".In a standard communication system which employing convolutional codes ,the Viterbi decoder is used to find the information bits that map to the code vector that is closest to the received vector. Next section is sum code based DPC schemes using LDPC Codes[6].The full form of LDPC is Low Density Parity Check codes and it will use higher order constellation to accommodate the auxiliary bits. Next is Sum Code Based DPC Schemes Using LDPC Codes, where LDPC stands for Low Density Parity Check codes[6]. Because of the use of high constellations to includes the auxiliary bits its complexity will increase. Because of the higher complexity prefer LDPC which will prefer approximately same efficiency.

When we take a large network with many users in communication system, complexity of the system will increase. When number users increase finding the sum rate of such system is difficult. In order to minimize the complexity of such system select a best user subset among from whole users. In order to maximize the data rate or sumrate introduce a user selecting procedure in MIMO channel. Here the dirty paper coding technique is not have been used ,when the number of users increases complexity of the scheme will increase. Thus select a best user subset in order to reduce the complexity and data collision[1]. Basically the user selection problem is solved by using" majorization minimization technique"[8]

Majorization Minimization technique which will provide a control in originating problem-driven procedures with low computational rate.The Majorization Minimization steps includes two steps[8]. The initial step is majorization step, here find a proxy function that approaches the independent function with their difference reduced at the present point. Then next is our final step that is minimization step, here minimize the proxy function .Aparallel statement can be made for maximization problems by swapping the upperbound minimization step by a lowerbound maximization step, and is mentioned to as minorization-maximization.

III. Conclusion

Here we have discussed about sum rate maximization and user selection. User selection plays a critical role in communication system when it comes to transmitting data over multiple input multiple output channels. The main advantage of user selection in communication environment is to maximize the sum rate when data transmits over MIMO channels. Also discussed different ideas and methodologies about sum rate maximization and user selection.

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