Tradeoff between Energy and Spectral Efficiency for Massive MIMO Systems with Transmit Antenna Selection

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Abstract— This paper presents the Energy Efficiency-Spectral Efficiency (EE-SE) trade-off for massive Multiple-Input Multiple-Output (MIMO) and Transmit Antenna Selection (TAS) schemes. The power consumption model (PCM) is taken into account, and it is shown that use of TAS will give significant energy savings when compared to massive MIMO within the low to medium spectral efficiency location, regardless the number of antenna elements. If the range of receive antennas is fixed, the energy efficiency gain using TAS becomes even larger with the increasing number of transmit antennas. The optimum value of spectral efficiency that minimizes the energy consumption is obtained in closed-form and confirmed by numerical results.

Key words: Massive MIMO, Energy Efficiency, Spectral Efficiency, Transmit Antenna Selection

I. Introduction

MASSIVE MIMO is one of the potential techniques to satisfy the requirement of high spectral efficiency (SE) and energy efficiency (EE) for successive wireless networks .It has been evidenced that, in large MIMO systems, the simple linear precoders and detectors are asymptotically best in terms of capability once the number of antennas at the base station tends to eternity. Alongside the spectral efficiency, the energy efficiency will also need to be improved by concerning identical quantity because the rate that may be a difficult issue for the long run wireless networks. Without considering the circuit power consumption, large MIMO will improve energy efficiency by three orders of magnitude.

This is conjointly presumably achieved by the simple linear process like zero forcing (ZF), maximum ratio transmission/combing (MRT/MRC). The two most outstanding linear precoders, ZF and MRT, are compared with relation to the SE and EE during a single-cell massive MIMO system. With considering the circuit power consumption, it is shown that massive MIMO setup is that the EE-optimal design. These works concentrate on the only cell situation. The EE of multi cell network with massive MIMO has also been investigated, that is analysis direction for future cellular networks.

II. Literature survey

Daehan Ha et al (2013) [13] proposed the required transmit power to support a target possible rate is inversely proportional to the number of antennas in massive multiple input multiple output (MIMO) systems. However, the consumed power of the large MIMO systems should include not only transmit power however additionally the fundamental power for operational the circuit at the transmitter, as a result of the impact of circuit power consumption is a lot of serious once the transmitter is provided with large range of antennas. Hence, to research the precise power consumption of large MIMO systems, the energy efficiency for multiple cellular systems with large-scale antenna arrays under a consideration of circuit power consumption of every antenna. Through new energy efficiency formulation based on the power consumption model, analyze the tendency of the energy efficiency as the range of antennas will increase and might see that the energy efficiency becomes a quasi-concave operate with regard to the number of antennas.

H.Q.Ngo et al (2013) [3] presented the energy efficiency design for uplink multiuser SIMO systems with stamped channel state information (CSD) at the base station (BS). Since the CSD at the BS is continually problematic on account of the channel estimation error and delay, the imperfectness of the CSD should be considered in practical structure design. It causes inter user impedance at the zero-forcing (ZF) receiver and makes it hard to acquire the universally ideal power distribution that expands the energy efficiency (EE).It causes inter user impedance at the zero-forcing (ZF) receiver and makes it difficult to secure the all around perfect power distribution that extends the energy efficiency (EE).The proposed system is used to look at the execution of broad scale MU-MIMO structure by changing the amount of BS receivers, users and recognize the effect on limit, spectral efficiency, total rate, energy efficiency so on. The proposed work is arranged and examined capably procedure/system for improvement of energy efficiency and throughput.

I. Das et al (2006) [15] presented the Normal Boundary Intersection (NBI) method for creating Pareto optimal solutions of power systems Environmental/ Economic dispatch (EED). The problem is displayed as a multi objective optimization program in which the goal is to limit the objective is to minimize the total cost of generation units and thermal units' emission of pollutants, subject to the provider physical limitations and transmission losses. The proposed approach is applied to a sample power system and simulation results are presented. The results demonstrate the capacities of the proposed way to deal with create uniformly disseminated Pareto sets of the multi objective EED problem. The comparison with the classical techniques exhibits the prevalence of the proposed approach and confirms its potential to solve the multi objective EED problem. Furthermore, it is very direct to stretch out the proposed model to include more objective functions.

C.Xiong et al (2011) [11] suggested the Conventional design of remote system mainly focuses on system capacity and spectral efficiency (SE). As green radio (GR) turns into an inescapable pattern, energy-efficient design in remote systems is becoming more and more important. In this paper, the major relation between EE and SE in downlink orthogonal frequency division multiple access (OFDMA) networks is addressed. In the first place set up a general EE-SE tradeoff structure, where the general EE, SE and per user quality-of-service (QoS) are all considered, and demonstrate that EE is strictly quasi concave in SE. It additionally locates a tight upper bound and a tight lower bound on the EE-SE curve for general scenarios, which reflect the real EE-SE relation. Then focus on a special case that priority and fairness are considered and develop a low-complexity but near-optimal resource allocation algorithm for practical application of the EE-SE tradeoff. Numerical outcomes corroborate the theoretical findings and show the effectiveness of the proposed resource allocation scheme for accomplishing a flexible and suitable tradeoff between EE and SE.

H.Li.L.Song et al (2014) [8] discussed the transmit antenna to enhance the energy efficiency of large scale multiple antenna systems. A good estimation of the dispersion of the shared information is derived in this transmit antenna systems. Channel hardening phenomenon is held 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. To begin with energy efficiency is registered by considering the circuit control utilization which dominates the transmit control and furthermore 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.

B.Sheng et al (2013) [12] propounded the mixture of energy harvesting and large scale multiple antenna technologies presents a promising solution for improving the energy efficiency (EE) by means of exploiting renewable energy sources and reducing the transmission power in keeping with user and consistent with antenna. But, the introduction of energy harvesting talents into large-scale multiple antenna systems poses many new challenges for energy-efficient system design due to the intermittent characteristics of renewable energy sources and restrained battery ability. Number of antenna, battery capablity, and EE-SE tradeoff are analyzed and verified through computer simulations.

B.M Lee et al (2013) [9] described the Massive multiple input multiple output require number of base station antenna serving for significantly more modest number of terminals, with extensive picks up in energy efficiency and spectral efficiency contrasted and conventional innovation. Large scale antenna means large scale radio frequency (RF) chains. Considering the a lot of energy utilization and high cost of RF chains, antenna selection is determined for fundamental Massive MIMO wireless communication systems in both transmitting end and receiving end. An energy efficiency antenna selection algorithm based on convex optimization was proposed for Massive MIMO wireless communication systems. On the condition that the channel capacity of the cell is larger than a specific threshold, the number of transmit antenna mutually optimized to expand energy efficiency.

S.Cui et al (2008) [14] presented the inventive innovation of large scale multi antenna systems will be sent in the fifth generation of mobile cellular networks. With a specific goal to render this innovation achievable and efficient, many difficulties must be researched before. In this paper the problem of antenna selection and user scheduling for Massive MIMO systems. The goal is to augment the aggregate of broadcasting information rates accomplished by all the mobile users in one cell served by a massive MIMO transmitter. The optimal solution of this problem can be acquired through a highly complex exhaustive brute force search (BFS) over every single possible combination of antennas and users. This BFS solution cannot be executed practically even for little size systems because of its high computational complexity.

III. CONCLUSION

In this survey paper, the energy efficiency is a characteristic of spectral efficiency, the number of antennas for TAS and massive MIMO schemes. Furthermore, the most effective spectral efficiency value that maximizes the power efficiency of the TAS scheme, for a given number of antennas, is obtained in closed-form and supported by numerical consequences. Hence it concludes that the TAS can be greater energy efficient than massive MIMO within the low spectral efficiency location with the number of antennas.

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