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REVIEW OF THE PILOT CONTAMINATION PROBLEM FOR MASSIVE MIMO AND POSSIBLE SOLUTION

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ABSTRACT
With the increasing demands of data communication speed for different type of data transmission, many revolutions occur with time in wireless communication system. The use of MIMO for wireless data transmission has proven itself for enhancing the capacity of data transmission. The mobile network based on the cell structure also uses the MIMO techniques. Further research in the field of massive MIMO has started for faithful data transmission. The enhancement by massive MIMO encounters many problems related to the implementation. One of the biggest challenges for massive MIMO is the pilot contamination. In this paper, Massive MIMO along with the pilot contamination is described. The research work presented by the researcher on this topic has summarized which also includes the possible solution to this problem.

Keywords: Pilot contamination, Massive MIMO, OFDM, Mobile network etc.

INTRODUCTION
Multiple-antenna (MIMO) technology is becoming mature for wireless communications technique and has been incorporated into wireless broadband standards like LTE and Wi-Fi technique. Basically, the more antennas the transmitter/receiver is equipped with, the more the possible signal paths and the better performance in terms of data rate and link reliability. The price to pay is increased complexity of the hardware and the complexity and energy consumption of the signal processing at both ends.
Massive MIMO (Large-Scale Antenna Systems, Very Large MIMO, Hyper MIMO, Full-Dimension MIMO and ARGOS, etc) makes a clean break with current practice through the use of a very large number of service antennas that are operated fully coherently and adaptively. Extra antennas help by focusing the transmission and reception of signal energy into ever-smaller regions of space. This brings huge improvements in throughput and energy efficiency, the particularly when combined with simultaneous scheduling of a large number of user terminals. Massive MIMO was originally envisioned for time division duplex (TDD) operation, but can potentially be applied also in frequency division duplex operation.

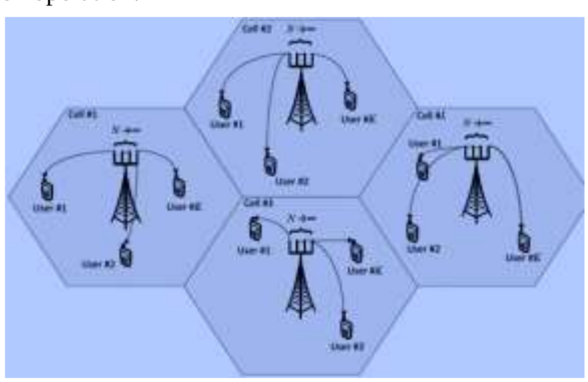

Fig: 1 Massive MIMO structure for mobile network

Figure-1 shows massive MIMO structure for mobile network. Other benefits of massive MIMO include the extensive use of inexpensive low-power components, simplification, reduced latency of the media access control (MAC) layer, and robustness to interference and intentional jamming. The anticipated throughput depends on the propagation environment providing asymptotically orthogonal channels to the terminals, and the experiments have so far not disclosed any limitations in this regard. While massive Multiple Input Multiple Output (MIMO) renders many traditional research problems irrelevant, it uncovers entirely new problems that urgently need attention; for example, in the challenge of making many low-cost low-precision components work effectively together, the need for efficient acquisition system for channel state information, resource allocation for newly-joined terminals, the exploitation of extra degrees of freedom provided through an excess of service antennas, reducing internal power consumption to achieve total energy efficiency reductions, and finding new deployment scenarios.

The major problem faced in massive MIMO is Pilot Contamination. In massive MIMO Pilot sequence used by user should be orthogonal within the same cell and the neighboring cells. But within a given Bandwidth the number of orthogonal Pilot sequences are limited.

TECHNIQUES FOR MITIGATING PILOT CONTAMINATION

Protocol Based Technique:- In this Technique, to reduce the effect of Pilot Contamination is done by frequency reuse or decreasing the number of served users who are using non-orthogonal Pilot sequence. By this Technique only for some specific cases, improvement in performance can be seen. But generally, since fewer user are served simultaneously, frequency reuse may make little difference even though for specific users the SINRs increase.

Precoding Technique:- In This at one base station the precoding Matrix is designed to reduce the sum of the squared error of its own users and interference to the users in other cells. This technique is based on multicell cooperation. However, as there is an increament in the number of antennas, the information exchange overhead increases among the base stations. So, this technique is used for MIMO systems having limited number of antennas.

Blind Technique:- The Blind Technique is based on subspace partitioning. The Blind Pilot decontamination technique is used for systems with power controlled handoff strategy and this technique can separate the subspace with interference from the desired signal subspace, which results in no pilot contamination.

LITERATURE REVIEW

The many researchers have been done in field of economic dispatch problem some of the work is described in this paper.

The author Jakob Hoydis consider a multicell MIMO uplink channel where each base station (BS) is equipped with a large number of antennas N. The BSs are assumed to estimate their channels based on pilot sequences sent by the user terminals (UTs). Recent work has shown that, as $N \rightarrow \infty$, (i) the simplest form of user detection, i.e., the matched filter (MF), becomes optimal, (ii) the transmit power per user terminals can be made arbitrarily small, (iii) the system performance is limited by pilot contamination. Aim of this paper is to assess to which extent the above conclusions hold true for large, but finite N. In particular, we derive how many antennas per user terminals are needed to achieve η % of the ultimate performance. Then they studied about how much can be gained through more sophisticated minimum-mean-square-error (MMSE) detection and how many more antennas are needed with the MF to achieve the same performance. Our analysis relies on novel results from random matrix theory which allow them to derive tight approximations of achievable rates with a class of linear receivers.[1]

The another author Deli Qiao interested to find out extra benefits that may be brought by distributing the massive number of antennas to different levels. Specifically, we compare the performance of co-located and distributed deployment scenarios in the framework of area spectrum efficiency and area energy efficiency (AEE) tradeoff. Closed-form expressions are derived to help discover important design insights. For instance, it is interesting to see the distribution of the massive antennas always helps to improve area spectrum efficiency (ASE), but not the case for area energy efficiency (AEE). Moreover, with the large number of transmit antennas available and the practical cost of channel estimation considered, for the collaboration between cells is not always welcomed in each deployment scenario and the positive use cases depend on scheme parameters such as the number of antennas and the way they are distributed.[2]

Lu Lu**,** done study in this paper, multiple-input multiple-output wireless communications network refers to the idea equipping communication cellular base stations (BS)with a very large number of antennas, has been shown to potentially allow for orders of magnitude improvement in spectral and energy efficiency using relatively simple processing. We present a comprehensive overview of stateoftheart research on the topic, in which has recently attracted considerable attention. The conjectured advantages of massive multiple input multiple output (MIMO), and then we address implementation issues related to communication channel estimation, detection and pre-coding method. We particularly focus on the potential impact of pilot contamination caused through in the use of non-orthogonal pilot systems by users in adjacent cells. It is also analyze the energy efficiency achieved by massive MIMO technique, and demonstrate how the degrees of freedom provided by massive multiple-input multiple-output systems enable efficient single-carrier transmission. In the finally, challenges and opportunities associated with implementing massive multiple input multiple output in future wireless communications systems are discussed [3].

Marios Kountouris, in this paper, the consider a heterogeneous cellular network where a microcell tier with a large antenna array base station is overlaid with a dense tier of small cells. We investigate the potential benefits of incorporating massive MIMO Base Station (BS) in a TDD-based heterogeneous cellular network (HetNet) and we provide analytical expressions for the coverage probability and the area spectral efficiency using stochastic geometry scheme. The duplexing mode in which SCs should operate during uplink macro cell transmissions is optimized. We consider a reverse TDD scheme, in which the massive MIMO base station (BS) can estimate the SC interference covariance matrix. Results suggest that significant throughput improvement can be achieved through exploiting interference and implicit coordination across the tiers due to flexible and asymmetric TDD operation. We provided analytical expressions to evaluate the coverage probability and area spectral efficiency in both uplink and downlink and we optimized the uplink/downlink technique mode of small cells. Furthermore, we showed how the macro base station (BS) can leverage the reciprocity-based interference covariance matrix information to significantly improve the SC throughput in a reverse-TDD mode. In investigating the potential benefits by using massive MIMO systems as a wireless backhaul solution for small cells is a promising research direction [4].

Tadilo Endeshaw Bogale,there have been active research activities worldwide in developing the next-generation fifth generation wireless network. The 5G network is expected to support significantly large amount of mobile data traffic and huge number of wireless connections, in achieve better cost- and energy-efficiency as well as quality of service in terms of communication delay, an reliability and security. To this end, the 5G wireless network should exploit potential gains in different network dimensions including super dense and heterogeneous deployment of cells and massive antenna arrays and utilization of higher frequencies, in particular millimeter wave frequencies. Then, the significance of massive MIMO and mm Wave in engineering the future 5G heterogeneous cellular network(HetNet) is discussed in detail. Potential challenges associated with the design of such 5G HetNet are discussed. In provide some case studies, in which illustrate the potential benefits of the considered technology. We have also presented a potential HetNet architecture that we have then presented three case studies addressing some of the challenges and showing their benefits. This article lays out the potential architecture and points out the underlying research challenges, in which must be addressed to meet the technical requirements of the future 5G network [5].

CONCLUSION

The study on the pilot contamination is described in this paper. There are many solution has been proposed by researcher with the limited scenario or theoretical scenario. The author Deli Qiao, has shown an significant improvement in solving the problem of contamination. It was observed that many parameters need to be optimized during the implementation of massive MIMO based network structure. There is possibility to use evolutionary methods to design an optimum network.

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