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A Comprehensive Study of Different Mechanism of Massive MIMO System for Compressive Sensing

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Abstract- Multiple Input-Multiple Output (MIMO) systems have turn out to be necessity of wireless communication systems to conquer bandwidth restrictions. Massive-MIMO systems are capable of improving the channel capability of the system. This paper presents review on design, architecture, challenges, limitations and the possible improvements in a Massive-MIMO system. Comprehensive study has been performed to build up substantial understanding about various designs, architectures and techniques described so far by enthusiastic research scholars regarding system model and practical implementation of the Massive-MIMO systems. The review is paying attention on the problems like, getting true channel state information, antenna correlation, channel estimation, signal detection schemes at receiver end, different kind of possible network architectures and their complexity and hardware impairments. Brief information is added about the projects running worldwide on Massive-MIMO and its application in future communication systems of next generation. It is observed that multiple antenna systems with huge amount of antenna elements at base station are competent to increase data rate by many folds, without requirement of any extra bandwidth, as compared to other existing technologies. Massive-MIMO combined with multiple carrier systems (Massive-MIMO-OFDM) followed by suitable signal detection schemes, like beam forming, gives overwhelming results. With possibilities of further research and continuous improvements, Massive-MIMO system is one of the best suitable choices, among various technologies, for next generation wireless communication systems, like 5G.

KEYWORDS: Massive MIMO, MIMO, MIMO-OFDM, Channel Estimation, 5G.

I INTRODUCTION

Over the last few years, massive multiple-input multiple-output (MIMO) has shown up as an emerging technology for wireless communication systems. Featuring up to thousands of transmit/receive antennas, the possibility of creating extremely narrow beams for many users is gaining the attention of industry and academia. Researchers are focusing their efforts on the promised benefits of this technology to create the next generation of communication systems. The underlying idea is to scale up the number of antennas at the base station (BS) by at least two orders of magnitude. The end effects of indefinitely increasing the number of antennas are small fading effects and additive noise. In a multiuser MIMO scenario, Massive MIMO opens the possibility to steer many spatial streams to dozens of pieces of user equipment (UE) in the same cell, at the same frequency, and at the same time. Mobile networks are currently facing rapid traffic growth from both smartphones and tablets. Sequential improvements of service quality set the new challenge of increasing wireless network capacity about a thousand times within the next decade, but no current wireless access technique can provide a significant improvement in capacity. A possible solution to cope with such a capacity demand is through network densification by adding small cells (SCs) (pico-cells and femtocells) that operate at high frequencies (e.g. 60 GHz) within the macro cell area.

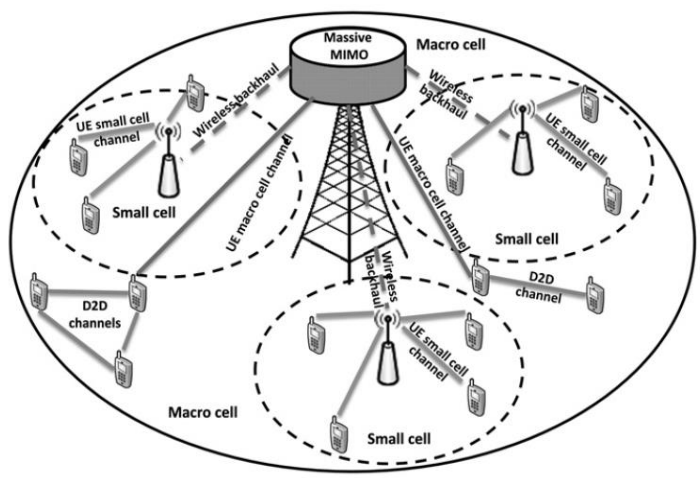

Figure 1 Architecture of HET-NET

SCs that utilize the same band spectrum can increase the capacity of a mobile network from 10 to 100 times, depending on the number of SCs and frequency reuse method. The energy efficiency of massive MIMO and SC has been studied. The authors proved that massive MIMO has better energy efficiency when the number of SCs is low, while SC offers better performance when the number of SCs is high.

However, a globally optimal trade-off between massive MIMO and SC efficiency is hard to achieve due to dynamic network behavior. A viable solution could be found by converging massive MIMO, SCs, and device-to-device (D2D) communications into a single cloud-controlled heterogeneous network (Het-Net), as shown in figure 1.

In this paper we discussed introductory part in section 1 and literature part discuss in section 2. Section 3 describe the problem identification and objective and conclusion describe the section 4 and 5 respectively.

II RELATED WORK

In this section we describe the literature of different methodologies related to massive MIMO, MIMO detection and MIMO-OFDM.

In 2017 IEEE Transaction on Communication Di Zhang et al. [1] proposed that the non-regenerative massive multi-input-multioutput (MIMO) non-orthogonal multiple access (NOMA) relay systems are introduced by this study. The NOMA is invoked with superposition coding technique at the transmitter and successive interference cancellation (SIC) technique at the receiver. In addition, a maximum mean square error (MMSE)-SIC receiver design is adopted. With the aid of deterministic equivalent and matrix analysis tools, closed-form expression of the signal to interference plus noise ratio (SINR) is derived. To characteristic the performance of the considered systems, closed-form expressions of the capacity and sum rate are further obtained based on the derived SINR expression. Insights from the derived analytical results demonstrate that the ratio between the transmitter antenna number and the relay number is a dominate factor of the system performance. Afterwards, the correctness of the derived expressions are verified by the Monte Carlo simulations with numerical results. Simulation results also illustrate that: i) the transmitter antenna, averaged power value and user number display the positive correlations on the capacity and sum rate performances, whereas the relay number displays a negative correlation on the performance; ii) the combined massive-MIMO-NOMA scheme is capable of achieving higher capacity performance compared to the conventional MIMONOMA, relay assisted NOMA and massive-MIMO orthogonal multiple access (OMA) scheme.

In 2017 IEEE Magazine K N R Surya Vara Prasad et al. [2] make progress toward the 5G of wireless networks, the bit-per-joule energy efficiency (EE) becomes an important design criterion for sustainable evolution. In this regard, one of the key enablers for 5G is massive multiple-input multiple-output (MIMO) technology, where the BSs are equipped with an excess of antennas to achieve multiple orders of spectral and energy efficiency gains over current LTE networks. Here, we review and present a comprehensive discussion on techniques that further boost the EE gains offered by massive MIMO (MM). We begin with an overview of MM technology and explain how realistic power consumption models should be developed for MM systems. We then review prominent EE-maximization techniques for MM systems and identify a few limitations in the state-of-the-art. Next, we investigate EE-maximization in "hybrid MM systems," where MM operates alongside two other promising 5G technologies: millimeter wave and heterogeneous networks. Multiple opportunities open up for achieving larger EE gains than with conventional MM systems because massive MIMO benefits mutually from the co-existence with these 5G technologies. However, such a co-existence also introduces several new design constraints, making EE-maximization non-trivial. A critical analysis of the state-of-the-art EE-maximization techniques for hybrid MM systems allows us to identify several open research problems which, if addressed, will immensely help operators in planning for energy-efficient 5G deployments.

In 2017 IEEE Transaction on Communication Qurrat-Ul-Ain et al. [3] presented that the full-dimension multiple-input multiple-output (FD-MIMO) technology, which is currently an active area of research and standardization in wireless communications for evolution towards Fifth Generation (5G) cellular systems. FD-MIMO utilizes an active antenna system (AAS) with a two-dimensional (2D) planar array structure that not only allows a large number of antenna elements to be packed within feasible base station form factors but also provides the ability of adaptive electronic beamforming in the three dimensional (3D) space. However, the compact structure of largescale planar arrays drastically increases the spatial correlation in FD-MIMO systems. In order to account for its effects, the generalized spatial correlation functions for channels constituted by individual elements and overall antenna ports in the AAS are derived. Exploiting the quasi-static channel covariance matrices of users, the problem of determining the optimal down tilt weight vector for antenna ports, which maximizes the minimum signal to-interference ratio of a multi-user multiple-input-single-output system, is formulated as a fractional optimization problem. A quasi-optimal solution is obtained through the application of semi-definite relaxation and Dinkelbach's method. Finally, the user-group specific elevation beamforming scenario is devised, which offers significant performance gains as confirmed through simulations. These results have direct application in the analysis of 5G FD-MIMO systems.

In 2017 IEEE Transaction on Selected Areas in Communication Xin Liu et al. [4] presented that the Non-orthogonal multiple access (NOMA) has been considered as a highly efficient communication technology in the fifth generation (5G) networks by serving multiple users concurrently through non-orthogonal sharing communication resources. NOMA can be combined with both massive multiple input multiple output (MIMO) and relaying technologies to further improve 5G system efficiency at the cost of increased complexity. These combinations rely on the efficient utilization of three-dimensional (3D) communication resources. In the first part of this paper, we investigate highly efficient 3D resource allocation for massive MIMO-NOMA systems. Due to hardware complexity constraints and channel variation in the massive MIMO-NOMA system, efficient antenna selection and user scheduling algorithms are proposed for sum rate maximization. In the second part of this paper, a collaborative NOMA assisted relaying (CNAR) system is proposed to serve multiple cell-edge users by 3D resource utilization. To reduce the relaying complexity in CNAR system, a simplified-CNAR (S-CNAR) system is proposed as an alternative NOMA enabled relaying strategy. Numerical results show that our antenna selection and user scheduling algorithms achieve similar performance to existing methods with reduced complexity. Under high target rate, CNAR obtains better performance over other transmission strategies and S-CNAR reaches similar performance by simplified relaying scheme.

In 2017 IEEE David M. Gutierrez Estevez et al. [5] proposed that the both the use of very large arrays of antennas and flexible time division duplexing (TDD) designs have become prominent features of next generation 5G cellular systems. However, both enabling technologies suffer from severe interference effects, respectively known as pilot contamination and base-station-to-base-station (B2B) interference. In this paper, a practical novel TDD design principle is proposed for massive multiple-input multiple-output (MIMO) heterogeneous networks (Het-Nets) that leverages the inherent features of a flexible TDD design to mitigate both the beam formed interference caused by the pilot contamination effect and B2B interference. The design is based on the key observation that the transmission path chosen for training by the non-massive MIMO base stations plays an important role in the interference behavior of the network, and the data slots need to be configured accordingly. We propose TDFLEX, a low-complexity heuristic solution that follows these design guidelines. Performance evaluation results show significant gains when our design is compared to the standard TD-LTE.

In 2016 IET Manish Madloi et al. [6] presented study, the authors propose an improved multiple feedback successive interference cancellation (IMF-SIC) algorithm and an ordered IMF-SIC (OIMF- SIC) algorithm for near-optimal multiple-input multiple-output (MIMO) detection. In particular, the multiple feedback (MF) strategy in successive interference cancellation (SIC) detector is based on the concept of shadow region, where, if a decision falls in the shadow region, then multiple neighboring constellation points are used in the decision feedback loop followed by the SIC technique, and the best candidate symbol is selected by using maximum likelihood cost. However, while deciding the best symbol, the shadow condition is not checked in the subsequent layers which may result in an unreliable decision. Thus, to improve the accuracy of a decision, the authors propose an improved MF strategy where the shadow region condition is checked recursively. Further, the authors also propose an OIMF-SIC algorithm where the log likelihood ratio based dynamic ordering is utilized for ordering the detection sequence. Simulation results validate superiority of the proposed algorithms over the other SIC based detection techniques. In addition, to validate robustness of the proposed algorithms, BER performance is computed and compared under channel state information mismatch.

III PROBLEM IDENTIFICATION

We found another very well summarized list of challenges about Massive MIMO from 3GPP R1136362. If we assume that we are using a fixed antenna size relative to the wavelength (e.g., size of 1/4 wavelength, 1/2 wavelength etc), as the carrier frequency goes higher, the path loss increases. This means the absolute physical size of the antenna gets smaller as carrier frequency goes higher. It means we can put more antenna in the same area in higher carrier frequencies. Based on this facts, we may compensate the high path loss in high carrier frequencies by putting more antenna without increasing the total size of the antenna array. As the carrier frequency increases beyond roughly 10 GHz, diffraction will no longer be a dominant propagation mechanism. In this frequency, reflection and scattering will be the most important propagation mechanism for non-line of sight propagation link. As the carrier frequency goes higher, the penetration loss from propagating into a building tends to increase. This would make in building coverage impractical for BSs deployed outdoors with massive MIMO (i.e., using many antenna in the array), we can implement high gain adaptive beamforming that would produce the effect of increasing the coverage and create less interference in the system (because the beam width gets very narrower).

IV OBJECTIVE

The main motto of this project is to explore massive MIMO with approximate message passing method to determine the channel estimation for wireless sensor network and analyses the energy efficiency aspect of such communication and show that using massive MIMO with AMP technique helps improving energy efficiency too.

- It can increase the capacity 10 times or more and simultaneously, improve the radiated energy efficiency in the order of 100 times.
- It can be built with inexpensive, low power consumption.

- It will enables a significant reduction of latency on the air interface (due to robustness against fading).
- It will simplifies the multiple access layer
- It will increases the robustness both to unintended manmade interference and to intentional jamming.

V CONCLUSION

In this paper we have highlighted the large potential of massive MIMO systems as a key enabling technology for future beyond 5G cellular systems. The technology offers huge advantages in terms of energy efficiency, spectral efficiency, robustness and reliability. At the base station the use of expensive and powerful, but power-inefficient, hardware is replaced by massive use of parallel low-cost, low-power units that operate coherently together. Great importance for next-generation wireless systems: multi-link, device-to-device, FD-MIMO, and mm-wave. The property of self-equalization was introduced for FBMC-based Massive MIMO systems. New Research Avenue towards a better understanding of waveform design for 5G with a particular emphasis on FBMC-based Massive MIMO networks. EE metric, network deployment strategies, energy-efficient network resource management, various relay and cooperative communications, MIMO and OFDM technologies.EE metric, network deployment strategies, energy-efficient network resource management, various relay and cooperative communications, MIMO and OFDM technologies.

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