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A Review on DMSTA Based Channel Estimation Techniques for Wideband Affected Massive MIMO Systems

Muhammed Rashid M[1], Padmam Gopinath Kaimal[2]

[1]Student, [2]Assistant Professor,
[1,2]Cochin College of Engineering and Technology, Valanchery, Kerala, India

ABSTRACT
Massive multiple input and output (MIMO) system is currently considered a promising technology to achieve the 5G generation of mobile communication requirements. There is a large no. of antennas used in transmitter and receiver side. The transmitted wideband signal will be sensitive to the propagation delay of electromagnetic wave across the large array aperture, which is called spatial wideband effect. The purpose of this report is to provide a survey of research related to Spatial wide band effect in massive MIMO System and propose suitable channel estimation techniques for mitigation of spatial wide band effect and pilot contamination problem.

KEYWORDS: *Massive MIMO, Spatial-wideband, Channel estimation, discrete Fourier transform*

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INTRODUCTION

Massive MIMO formed by equipping thousands of antennas at transmitter and receiver side of wireless communication system. The large number of antennas can improve spectral and energy efficiencies, data rate and network coverage. A large number of antennae at the base station can be achieved significant beam forming gain and the system capacity in mobile communication network. The base station requires an accurate knowledge of the channel state information to achieve the massive MIMO potential features. The channel state information is obtained by transmitting predefined pilot sequences and applying appropriate estimation algorithms. Perfect orthogonal pilot allocation to the users is required to attain the optimal channel estimation accuracy. But this requirement is not practical since the pilot overhead has to be proportional to the number of users in the system. The size of the channel coherence block limits the number of orthogonal pilots. The pilot signal needs to be reused in the neighboring cell which creating spatially correlated inter cell interference known as pilot contamination.

When a signal is transmitted it passes through channel. Therefore there is a spatial wideband effect at the receive end. So there is need of proper estimating the channel at the receiver side for proper reception of the transmitted signal. There are several ways to estimate the channel at the receiver end. The LMMSE and DMSTA- based DFT are some algorithms which are proposed for the estimation. This will provide better performance since BER is very low.

OVERVIEW OF CHANNEL ESTIMATION OF MASSIVE MIMO SYSTEMS

In the wireless communications, the employment of multiple antennas at both the transmitter and receiver greatly improve the link reliability and increase the overall system capacity. MIMO has been used in various wireless communication standards, such as the third generation (3G), fourth generation (4G), and fifth generation (5G) wireless systems. Massive MIMO refers to a very large multiuser MIMO technology, which uses many antenna arrays that simultaneously serve many single antennas terminals in the same time-frequency resource. The massive MIMO wireless channel is highly complex. Hence the channel should be estimated. Path loss, fading are some of the challenges which are facing in signal transmission and reception. In order to reduce these effects we propose a DMSTA-based algorithm which provide the better performance.

METHODS

The main interest of massive MIMO channel estimation is to estimate the effect of channel at the receiver end for better reception of the signal. In terms of research objectives, previous area can be divided into three categories. The first category which estimate channel based on the directly extended from the conventional MIMO channel model, second category which estimate channel with considering the spatial wideband effect but not considering pilot contamination problem and the third category which estimate channel with considering both spatial wideband effect and pilot contamination problem.

A. Detection Based on Directly extended from the conventional MIMO.

Signal detection implies accurate estimation of the transmit vector knowing the received vector and the channel. Channel estimation of massive MIMO can be done using linear or nonlinear algorithms. Linear detection generally generates soft estimates of the transmitted vectors [7]. Linear detection has less complexity but it has lower performance and limited spectral efficiency. The performance of linear detectors deteriorates rapidly as the number of transmitting antennas increases. Lattice Reduction (LR) of massive MIMO is based on linear detection . It has better performance than ordinary linear detection. However, instead of applying the linear transformation to the massive MIMO received signal model, they apply it to an equivalent system model obtained using LR-techniques. The new channel matrix is more orthogonal than the old one. Slicing is done on the received data vector instead of the transmitted vector.

B. Detection with considering spatial wide band Effect only.

The performance of massive MIMO systems depends on the favorable propagation delay condition equivalent to the asymptotic orthogonality of channel impulse vectors associated with different users in cells. In work [1] channel is usually modeled as the ideal Gaussian channel matrix with elements following the mutually independent Gaussian distribution, so that channel vectors associated with different users are asymptotically orthogonal and can provide the favorable propagation condition for massive MIMO system. The massive MIMO communications by considering the dual-wideband effects from the array signal processing [8] viewpoint. A massive MIMO channel with the spatial-wideband effects is modeled as a function of limited parameters such as the complex gain, the direction of arrival or the direction of departure , and the time delay of each channel path by exploiting the channel sparsity in both angle and delay domains. In massive MIMO systems, especially over mmWave-band, the narrowband assumption does not valid any more. In this case, the conventional massive MIMO channel model [6] and other models that directly extended from the conventional models will be inapplicable. The algorithms without considering the spatial-wideband effect will suffer from the performance loss when either the number of base antennas or the transmission bandwidth becomes large.

C. Detection with considering spatial wide band Effect and Pilot contamination problem.

In work [3] channel estimate with considering both spatial wideband effect and pilot contamination problem. When a signal propagates from the transmitter to the receiver, it experiences the effect of spatial effect, scattering, fading, and path loss in the channel. Knowing the channel impulse in both forward and reverse links is crucial for accomplishing successful transmission under various channel conditions. Training sequences are designed to optimize an equalizer at the receiver by providing channel impulse. In massive MIMO systems, the pilot signal is used to estimate the channel impulse in both directions. For downlink transmission, the pilot signal sample period should be longer than the number of transmitting base antennas. For uplink transmission, the pilot signal sample period should be longer than the number of users (K), so that the BS would learn the uplink channel matrix. Pilot contamination is a major problem in massive MIMO, which is caused by non-orthogonality of pilot signal used in adjacent cells. Usually, reusing pilots in multiple cells is the main cause of the problem. In this case, the estimated channel impulse vector in any cell is the summation of all the channel impulse vectors of users from the neighboring cells. As the number of interfering cells increase, the problem exponentially grows and eventually causes system malfunction.

CONCLUSION

We have presented a various channel estimation methods used in a massive MIMO system. The advantages and limitations of various estimation methods are described. However, channel estimation with considering spatial wideband effect and pilot contamination problem provides better performance. it allows for low BER and SNR. It can capture the sparseness of the system to provide better performance.

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