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Research on 5G Millimeter Wave Channel Estimation Algorithm

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ABSTRACT

With the explosive growth in the number of communication users and the huge demand for data from users, Limited low-frequency resources have been far from being satisfied by users. The combination of Massive MIMO technology and millimeter-wave technology has brought new hope to users. In this paper, several basic algorithms are placed under the millimeter wave large-scale antenna channel for simulation research.

Keywords: 5G, Mmwave, Massive MIMO, Channel Estimation Algorithm

I. INTRODUCTION

The current low-frequency band resources used by mobile communication technologies, with the proliferation of mobile communication users and the use of households have a strong desire for high data transmission rate requirements, and the spectrum resources of low frequency bands have become overcrowded and cannot be reached. 5G communication index requirements, so the application of millimeter-wave spectrum resources that have not been fully developed in the future 5G communication.The research has received the attention of researchers at home and abroad. On the one hand, the frequency band resources of millimeter waves are widely distributed and can be used for communication.The system provides a rich bandwidth. On the other hand, since the antenna size in a wireless communication system is proportional to the signal wavelength,the wavelength of the millimeter wave makes the corresponding antenna size greatly reduced, and it is suitable for deploying a large number of days at the base station and the receiving end.Line, which allows the system to achieve higher antenna array gain. Massive MIMO technology can effectively improve the system. The capacity, while reducing energy consumption and bit error rate, is also an important part of the current 5G key technology research.

Therefore, the perfect combination of millimeter wave and Massive MIMO technology is also due to abundant bandwidth resources and higher data transmission.Rate and energy efficiency have become the research hotspots in the current communication field. This article mainly unfolds on millimeter wave Massive Analysis and research of channel estimation algorithms for MIMO system.

II. Basic algorithm simulation study

This section compares the estimated performance of LS algorithm, MMSE algorithm, OMP algorithm, NOMP algorithm and CoSaMP algorithm in millimeter wave Massive MIMO system. Using the mean square error and computational complexity of these three algorithms as reference standards, the Matlab simulation platform is used for simulation experiments. The simulation parameters are shown in the table1.

TABLE I. SIMULATION PARAMETER SETTING

Parameter Name	Parameter Settings
Channel estimation method	LS MMSE OMP NOMP COSAMP
Antenna configuration	2*2
Channel model	Frequency selective fading
Channel length	32
Number of subcarriers	1024

The specific comparison of the algorithm is shown in the figure below.

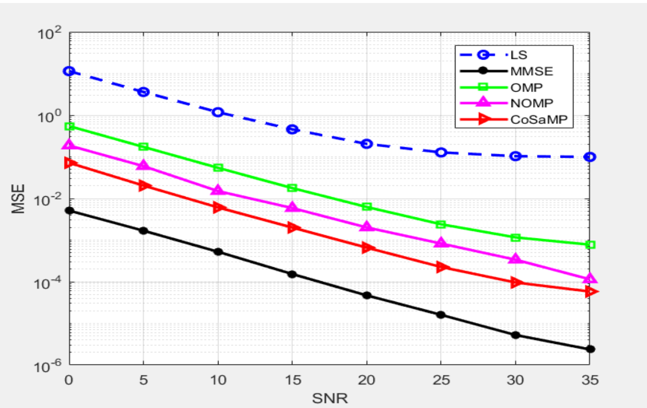

Figure 1 : Comparison of Mean Square Error of Several Algorithms

Figure 1 shows a schematic diagram of the mean square error of different algorithms as a function of signal-to-noise ratio. It can be seen from the figure that the mean square error of the LS, OMP, NOMP, CoSaMP and MMSE algorithms are decreasing as the SNR increases. When the range of SNR is between 0-15dB, the change of the mean square error is faster than that after 15dB, and the mean square error of the LS algorithm is nearly linear, with a slight change at 15dB. It can be seen from the figure that the values of the five channel estimation algorithms MSE are different under different SNR conditions, and the accuracy is not fixed, and a relatively suitable algorithm needs to be selected according to actual communication conditions.Similarly, in the mmwave Massive MIMO communication channel, the OMP algorithm is the most complicated.Below we have deep thinking about CoSaMP algorithm.

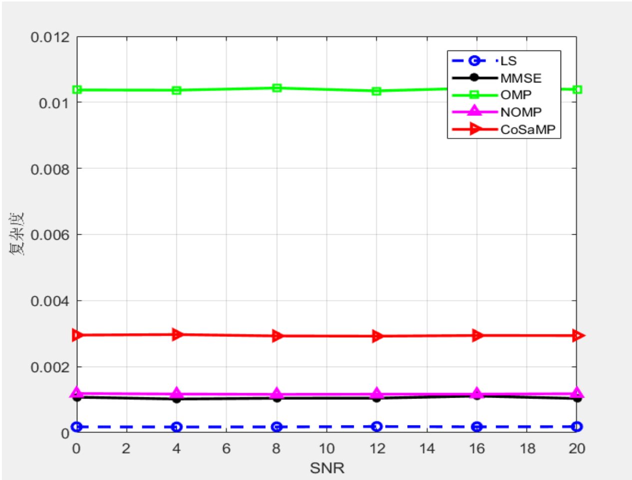

Figure 2 : Comparison of several algorithm complexity

In order to ensure the accuracy of the analysis results, this article carries out the Dingmont card age simulation. The number of simulated channels is generally set to 1000, and 1000 millimeter-wave MIMO channels are randomly generated for performance verification of the algorithm. Some of the other parameters used in the performance simulation analysis are as follows. The number of transmitting antennas N_T , the number of receiving antennas N_R o the number of radio link links, the number of N_{RF} transmission data streams N_S The number of transmit precoding modes is from beam, and the number of merge modes is N_{Tbeam}. Receive signal-to-noise ratio SNR on the receiving antenna. The dictionary matrix A_{RD} selected for sparse signal reconstruction. And A_{TD} . The atomic number D based on the CoSaMP algorithm based channel estimation method used in the estimation of the sparsity degree K.The performance index used in the simulation is the NMSE (normalized mean square error) of the channel estimation result with respect to the true value of the channel, and the calculation formula is expressed by Equation 1-1.

$$NMSR(\bar{H}) = \frac{E(\left\| \bar{H} - H \right\|_F^2)}{\left\| H \right\|_F^2} \qquad (1\text{-}1)$$

In equation (1-1), H is the result obtained using the channel estimation method, and H is the true value of the estimated millimeter wave MIMO channel. The smaller the calculated NMSE, the more accurate the estimated result, and the better the performance of the associated channel estimation method.

The following are performance simulations and related analyses in different situations.

(1) Set from $N_T = N_R = 32$, $N_{RF} = N_S = 4$, $N_{Tbeam} = 32$, $N_{Rbeam} = 32$,D and K take different values。 The performance of the NMSE based on the OMP and CoSaMP-based channel estimation method and the traditional LS method is simulated. The independent variable is the signal-to-noise ratio of the received signal. The result is as follows.

(2)

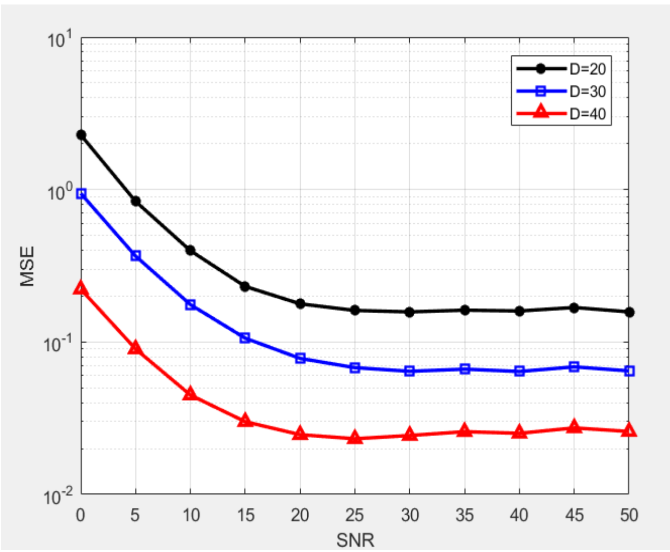

Figure 3 : MSE of CoSaMP algorithm when D takes different values

The atomic number D of the dictionary matrix is set to 20, 30, 40, 50 respectively, and the relationship between the performance of the CoAMP estimation method and the atomic number D of the dictionary matrix is simulated. The results are shown in Fig. 4. As can be seen from the figure, the estimated performance of the OMP estimation method in the dictionary matrix atomic number D of 40 and 50 is about 1 dB and 2 dB better than the case where D is 30, respectively. The larger the dimension of the dictionary matrix, the larger the calculation amount when matching the search. For example, when D is 50, the calculation of the perceptual matrix Q exceeds twice, and the performance is not significantly improved. Therefore, the atomic number D of the dictionary matrix is moderate, and 40 is the best.

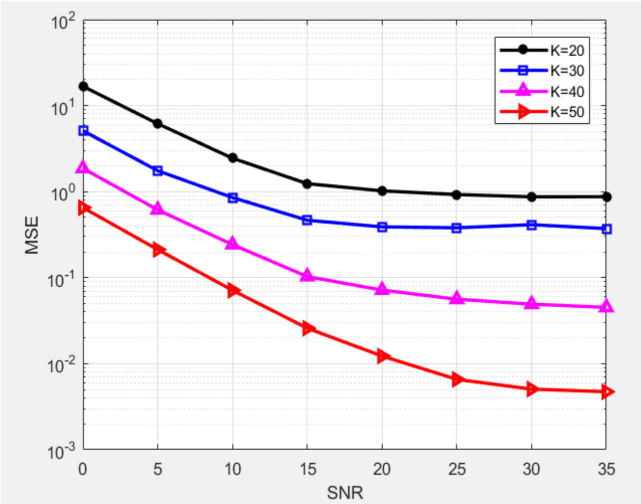

Figure 4 : MSE of CoSaMP algorithm when K takes different values

Figure 3 shows the channel estimation performance of the channel estimation method based on the CoSaMP algorithm when K takes different values. It can be clearly seen that the performance of the CoSaMP estimation method gradually becomes better as the value of the atomic number K increases. However, this improvement is not without an upper limit. When the value of K is greater than the critical value, the performance will be worse. Specifically, to Figure 3, when K is 20, the performance of the CoSaMP estimation method is very poor. When the value of 40K is the value of the NMSE obtained by using this method, the result is better than the value of K. When the value of K is 20, the value of NMSE is 30%, and the result of NMSE is 3dB better than the result of K. In several cases of simulation, the estimated performance when K is 40 is the most ideal.

III.CONCLUSION

In this paper, under the 5G millimeter wave massive MIMO channel estimation algorithm, this paper is mainly based on the research of CoSaMP algorithm, CoSaMP is compared with other algorithms, and the conclusion is obtained. The parameters of CoSaMP algorithm are changed, and the optimal value of the parameters is obtained through simulation.

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