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Maximum Likelihood Method to Estimate Channel State Information in NOMA-CoMP System

Reshma Ramachandran , Deepa T, Vishnu Priya P

Department of Electronics and Communication, MGM College of Engineering and Pharmaceutical Sciences,

Kerala, India

ABSTRACT: Non-Orthogonal Multiple Access (NOMA) is a promising technology in 5G mobile communications, to use spectrum efficiently. In this signals of users send together, hence there will be interference. We have to cancel this interference. This is done with the help of most advanced framework, called Coordinated Multi Point System (CoMP). At receiver side it decode its own signal and subtract the unwanted signal, in such a way that consider strongest signal as its own signal. There different ways we can utilize NOMA. Among them Coded domain and Power domain are mostly used. In this project we are allocating different power levels to each signal. Power allocated to each user with respect to their distance. The user nearest to the tower provided with least power and farthest user will get highest power. Estimation of Channel State information is difficult to do in NOMA system. Here we propose the technique Maximum likelihood to estimate the channel state information.

KEYWORDS: Non-orthogonality,Coordinated Multi Point system, Power allocation, Channel State Information, Maximum Likelihood

I. INTRODUCTION

5G network provide massive connection, lower latency, energy savingand increased bandwidth. The main feature is its high speed about 20 Gbps. 5G offers the chance of developments like far off medical procedures, telemedicine, self-driving vehicles, brilliant urban communities, shrewd structures and keen industrial facilities, computer generated reality experience while gaming, shopping and review games. It hopes to grow remote administrations from the web to the Internet of Things and correspondence sectors [1].

Lot of researches are going in 5G area. There are two approaches in multiple user access, Orthogonal Multiple Access and Non Orthogonal Multiple access. Orthogonal Multiple Access send user signals orthogonal to each other and shares its time or frequency slots. NOMA is a promising technology to improve the spectral efficiency of the network. The name non orthogonal came because, in this user signals are send together. NOMA allocate one frequency or time slot to multiple users. Hence there will be inter cell and intra cell interference happened. At receiver side we have to cancel the interference, Successive interference cancellation (SIC) done to decode the desired signal. So when compared with orthogonal multiple access system [2] the receiver design is complex. Non orthogonal scheme is possible with enhancement of chip processing technology.

Several types of NOMA have been explored, the most popular among these are Coded Domain Multiple access and Power Domain Multiple Access. We consider Power domain multiple access [3], allocating different power levels to each user. At the recipient side, every client removes its own sign by progressively demodulating, interpreting then re-encoding prior to deducting the progressively identified meddling signs. The progressive obstruction crossing out (SIC) requesting that expands the whole rate for downlink in single base station (BS) cells is finished as per the rising request of the client channel gains. That is, every NOMA client disentangles and deducts the signs of any remaining clients with more fragile channel gains prior to recovering its planned sign.

To cancel the interference we are using Coordinated Multi-Point (CoMP) transmission. The types of CoMP systems [4], [5]coordinated beam forming (CB-CoMP), Coordinated Scheduling (CS- CoMP), Dynamic Point Selection (DPS- CoMP) and Joint Transmission (JT- CoMP).In JT CoMP system users are served by two or more antennas. Hence the signal strength of this system is more compared to other CoMP techniques. So we consider this technique.CoMP techniques we are using for both inter-cell and intra-cell communications. To estimate Channel State Information (CSI). Several methods can be utilized such as Least Square (LS) method, Mean Minimum Square Error (MMSE) method and Maximum Likelihood (ML). In this paper we are using Maximum Likelihood method.

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II. RELATED WORK

There are number of papers available for NOMA system. Paper. Paper [6] describes the features of NOMA, types of NOMA systems, challenges and opportunities of NOMA systems. The rate coverage probability of user characterized user in NOMA characterized [7] by considering perfect SIC, imperfect SIC and imperfect worst case SIC. The overall description about NOMA-CoMP system described in paper [8]. They described mutual SIC conditions for different scenarios such as, two user system and three user system. In this calculated spectral efficiency of two user and three user system with JT CoMP and DPS CoMP systems. And got more spectral efficiency for three user system. Proved JT CoMP provides more spectral efficiency than DPS CoMP. Also they proved with SIC gives more spectral efficiency than No-SIC techniques (without SIC).They concluded that when number of users increases spectral efficiency also increases in the case of NOMA-CoMP system. But they mentioned that estimation of CSI is out of scope of their work. So in this paper done CSI estimation with the help of Maximum likelihood method.

This paper is coordinated as follows: Area II explained an outline of NOMA with CoMP system. Area III is partitioned into two subsections for the channel state information method: III. A depicted LS method, III.B introduced MMSE method. Segment IV introduced our proposed strategies & simulation result. Segment V is the conclusion of the project.

III.CHANNEL STATE INFORMATION IN NOMA-COMP SYSTEM

The signals of users are modulated (QPSK modulation), this signal can be expressed as S1 (t), S2 (t) …. Sm(t) from transmitter. These signals allocated with different power levels. These signals can shared the same time or frequency. That is at the same time we can share number of signals. The nearest user from the tower will provided with least power and far away from the tower will get highest power. That is the power allocation to users have fairness with distance. This signals with different power levels send together to the channel. Clients communicate their CSI to RRHs, and the BBU gathers all the CSI from RRHs what's more, shares them with other BBUs. Since imperfect CSI estimation is out of scope, in previous studies perfect CSI is assumed. So in this work we are calculating CSI with Maximum Likelihood method. The channel properties communication link gives Channel State Information. CSI describes the combined effect of scattering, fading and power decay with distance.

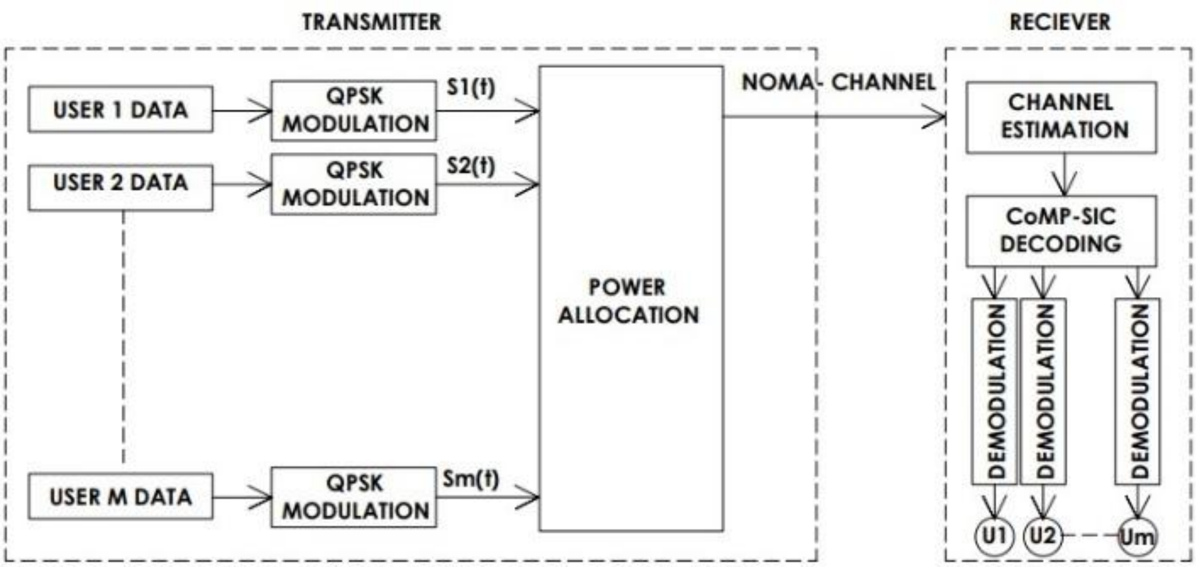

Fig. 1: Block diagram for estimation of NOMA-CoMP system.

The reference signal called pilot signals will be used to estimate CSI and it is given by,

$Y_p = X_p H_p + \lambda_p$ (1)

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Here $()_p$denotes the position of the piolet signal which is transmitted. H is the impulse response of the channel in one NOMA and $\lambda_p$is the AWGN channel noise.

CSI gives the information of how noise effect the user equipment and address the impact of fading. Here considered Rayleigh fading. The main challenge faced in estimation of CSI of NOMA system is pilot assignment. When number of pilot increases, the resources required also increases. In CSI estimation, pilot used during transmission and then compared with receiver pilots. Here estimation of CSI done without considering pilot contamination [9]. At receiver side the SIC decoder decodes its signal with the help of CoMP system. The user equipment will get signals of other users also, so it has to get its own signal. The decoding is done in such a way that, the strongest signal as its own signal. It subtracted unwanted signals and demodulated the desired signal.

A. Maximum LikelyHood method

Maximum likely hood starts with composing a numerical articulation known as the Likelihood Function of the example information. Freely talking, the probability of a bunch of information is the likelihood of getting that specific arrangement of information, given the picked likelihood circulation model. This articulation contains the obscure model boundaries. The upsides of these boundaries that boost the example probability are known as the Maximum Likelihood Estimates or MLEs.

Most extreme probability assessment is an absolutely insightful augmentation technique. It applies to each type of controlled or multicensored information, and it is even conceivable to utilize the procedure across a few pressure cells and gauge speed increase model boundaries simultaneously as life conveyance boundaries. In addition, MLEs and Likelihood Functions for the most part have truly attractive huge example properties:

i) They become fair-minded least fluctuation assessors as the example size increments

ii) They have rough ordinary circulations and surmised test differences that can be determined and used to produce certainty limits

iii) Likelihood functions can be utilized to test speculations about models and boundaries

There are just two disadvantages to MLEs, yet they are significant ones:

i) With small quantities of disappointments (under 5, and now and then under 10 is little), MLEs can be vigorously one-sided and the enormous example optimality properties don't matter

ii) Computing MLEs frequently requires particular programming for tackling complex non-direct conditions. This is to a lesser extent an issue as time passes by, as more measurable bundles are moving up to contain MLE investigation ability consistently.

IV. SIMULATION RESULTS

Numerical investigation of the performance of our proposed channel estimation method has done with ML method. Fig 2 shows the system performance with respect to Signal to Noise Ratio in dB and Symbol Error Rate (SER).This is done with different number of transmitters and receivers (Nt and Nr). This simulation has done in MATLAB.

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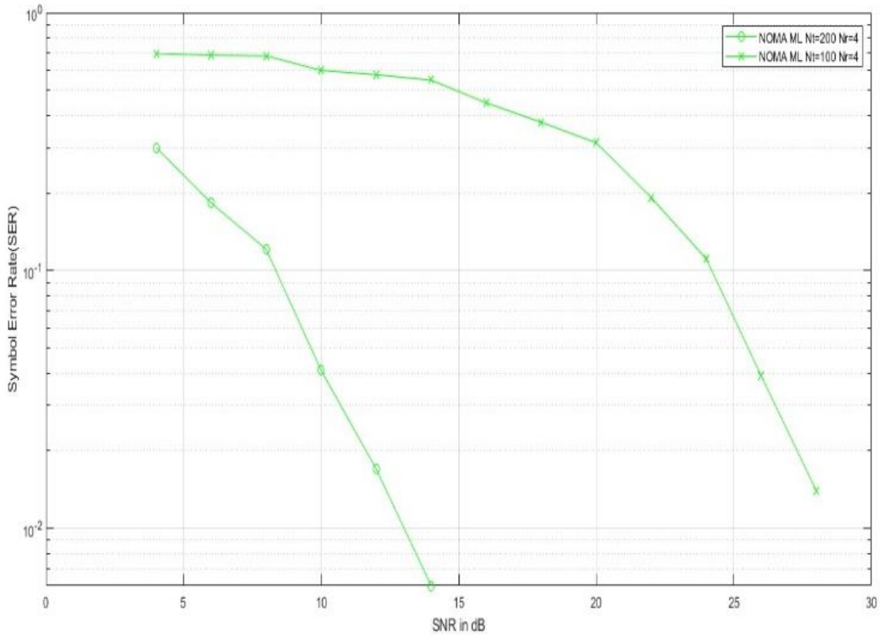
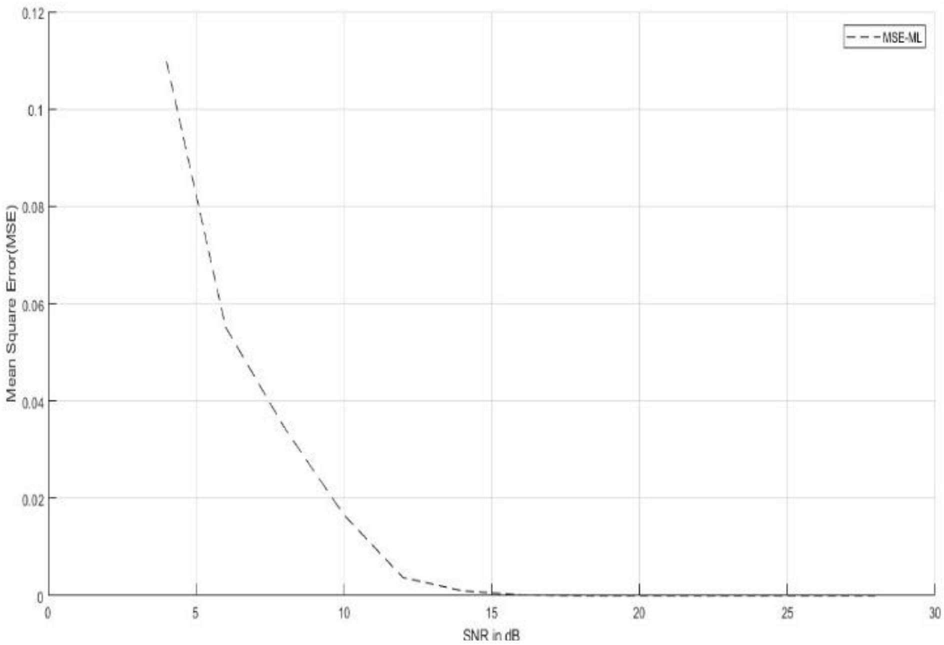


Fig. 2: SNR Vs SER of Maximum Likelyhood (ML) method to estimate CSI

From this, it is clear that when number of transmitters increase SER decreases. Here, we considered the number of the transmitter as 100 or 200. The Mean Square Error also calculated and gives the same result as MSE value reduced when number of transmitter increased as shown in Fig. 3.



V.CONCLUSION

NOMA is a promising innovation in 5G, which uses the spectrum effectively. Hence it support dense massive connection. In this when number of users increases its spectrum efficiency also increases. To cancel the interference we can use most advanced frame network called CoMP systems. The challenge faced in NOMA-CoMP system is estimation of imperfect Channel State Information Estimation (CSI). We can do CSI with Least Square (LS), Minimum Mean Square Error (MMSE) and Maximum Likelihood (ML).In this paper, we derive the solution to estimate channel state information methods of NOMA system by usingMaximum Likelihood (ML)methods. But piolet contamination is

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not considered in this. So this system can be upgraded by considering piolet contamination. Instead of using the above mentioned estimation methods we can use Neural Network also.

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