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NOMA-COMP SYSTEM CHANNEL STATE INFORMATION ESTIMATION METHODS – LS & MMSE

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Abstract: Non-Orthogonal Multiple Access (NOMA) with mutual successive interference cancellation is a promising technology in 5G mobile communications, to use spectrum efficiently. The key to NOMA is that signals have huge contrasts in power levels. It is then conceivable to thoroughly disengage the high-level signal at the recipient and afterward cancel it to leave the low-level signal. Same like this way, NOMA exploits the path loss among different users. In spite of the fact that it needs an extra power at the receiver. The two clients — those with high channel gains and those with low channel picks up advantage by being booked all the times and by being allocated more bandwidth. This implies that NOMA empowers framework limit and fairness of allocations to the improvement for all clients. In a NOMA framework, it is needed for a NOMA client to unravel and afterward drop (i.e., by utilizing SIC) signal for the other NOMA clients having earlier unraveling request. Since SIC is acted in the power domain, the co-channel macrocell impedance may make the little cell clients incapable to perform SIC. In this way, the execution of NOMA (without CoMP) in co-channel downlink HetNets would be very testing. Notwithstanding, the utilization of CoMP could be a likely answer for such a NOMA-based HetNet. In all the previous work, a known Channel State Information Estimation (CSI) is considered which is not practically possible. So here, we propose a method in which the CSI is estimated using Least Square (LS) and Mean Minimum Square Error (MMSE) methods. From the simulation it is found that, better channel estimation is possible with MMSE methods. Finally, the spectral efficiency is calculated with the known CSI method.

Keywords: Non-orthogonality, Power allocation, demultiplexing, Successive interference cancellation, path loss, Channel state Information, Least square, Mean minimum square error

I. INTRODUCTION

5G's quantum jump in network sets out huge freedom for various enterprises and makes way for a huge scope of disturbance. Ventures like medical services, assembling, and auto are now embracing advances and getting more associated. 5G gadgets are lower latency, empowering quicker transmission of larger information streams (these are more dependable), empowering better transmission of information in outrageous conditions. It is more adaptable than Wi-Fi and can uphold a more extensive scope of gadgets, wearables, and sensors.As one of the vital advances in 5G, NOMA has been proposed [1][2] and researched as an intention to improve the range of effectiveness for the framework.

In the downlink of the NOMA conspire various client terminals which are relegated similar recurrence assets. These client terminals are situated at various positions comparative with a base station. Several types of NOMA have been explored throughout the most recent couple of years, a significant part of the work around power area NOMA. Its central thought is to empower the concurrent access of numerous clients to similar frequency/time resources, by dispensing different power levels to clients, based on the client channel gains. At the beneficiary side, every client removes its sign by progressively demodulating, translating, and then re-encoding before taking away the progressively recognized meddling signs. As per [3], the progressive obstruction wiping out the request that boosts the aggregate rate for downlink in single base station (BS) cells. Every NOMA client translates and deducts the signs of any remaining clients with more fragile channel gains before recovering its planned sign. NOMA in detail, non-orthogonality is deliberately presented either as frequency, code or time. Then as the signal is received demultiplexing is acquired because of the huge force contrast between the two clients. To separate the sign, successive interference cancellation is done at the receiver. The channel gain consists of components including the path loss and SNR. The path loss and the SNR between different users are converted for multiplexing gains. Despite the fact that power-sharing diminishes the power allocated to every client.

Coordinated Multi-Point (CoMP) transmission is used among different cells to serve clients who encounter serious inter-cell interference (ICI). CoMP is interference between cell participation innovations that empowers more than one transmission cell to speak with a UE to accomplish better throughputs at cell edge regions by lessening between cell impedance. According to the ascending order of the user channel gain [4] the successive interference cancellation (SIC) ordering is done and that maximizes the sum rate for downlink in single base station (BS) cells.CoMP collaborating cells share channel data of a UE, and dependent on the data, transmission cell(s) are chosen. There are four CoMP techniques available [5] [6] those are coordinated scheduling (CS-CoMP), Coordinated beamforming (CB-CoMP), Dynamic Point Selection (DPS-CoMP) and Joint Transmission (JT –CoMP) methods. In this, we are considering two types of CoMP techniques. Joint transmission (JT) and Dynamic point selection (DPS) technique. CoMP techniques we are using for both inter-cell and intra-cell communications. NOMA-CoMP system (7) provides greater spectral efficiency when number of users increases.


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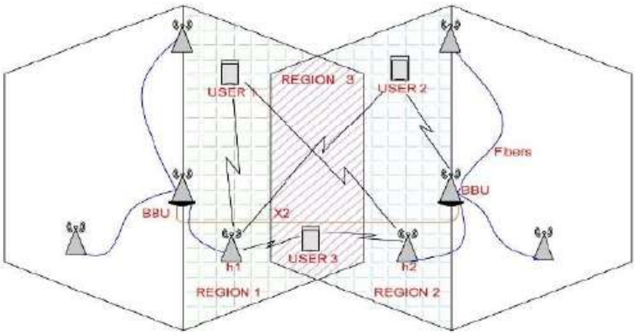
Many channel state estimation methods are utilized such as Least Square (LS) method and Mean Minimum Square Error (MMSE) method. These methods are used to estimate NOMA channel state information. Practically speaking, with the portability between the transmitter and the beneficiary, the remote channel is time-varying channel. To monitor the time-shifting channel trademark, may bring about an excess of pilot tones which causes information to decrease.

In this paper, our commitment is to analyze the exhibitions of LS and MMSE after differing channels for some time by utilizing brush type pilot plan. The main contributions of this paper are as follows:Estimation Bit Error Rate (BER) and Signal to Noise Ratio(SNR) by using channel state information methods such as MMSE and LS methods.

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.

II. SYSTEM DESCRIPTION



To describe this system, considering two cell downlink system which has one baseband unit connected by x2 cables, so the message can be transferred by using thiscable between BBU and each cell contains several Remote Radio Head (RRH). RRH and BBUs are connected by fibers. Consider three users, user 1 (non-edge cell) in cell region 1, user 2 (non-edge cell) in cell region 2, and user 3 (cell edge) in cell region 3 as shown in the figure.

The information from h1 & h2 passes to three users user1, user2 & user 3 by using non-orthogonal multiple access in the power domain. That is, we are allocating a high power level for a far user and a low power level to the nearest user. At the user end, we have to decode their signal by mutual Successive Interference Cancellation (SIC) with CoMP systems. Here we are considering DPS Scheme and JT CoMP systems. Mainly we used DPS when for user 1 gets signal from h1 only and Joint Transmission CoMP system used when user 1 served by h1 & h2. JT CoMP has given more spectral efficiency than DPS CoMP [8].Also when the number of users increases the spectral efficiency of the system also increased.

By Shannon capacity theorem the rate expression for a user m (When there is no interference with a full mutual SIC between the three clients) can be expressed as:

$$\text{Ck}=\begin{cases} Blog_2\left(1+\frac{P_{m,h}h_{m,h}}{n^2}\right) forDPS. & (1) \\ Blog_2\left(1+\frac{P_{m,h1}\ h_{m,h1}+P_{m,h2}\ h_{m,h2}}{n^2}\right) forJT, & (2) \end{cases}$$

B is the signal bandwidth normalized to one and n^2 is the noise power. Sum-rate maximization over the transmit power variables Pm,his given by

$$\max_{P_{m,h}} \sum_{i \in K} C_i \qquad (3)$$

The constraints which we have to follow in this is:

$$\begin{cases} MutualSICconstraints & (4) \\ PowerMultiplexingConstraints\ , & (5) \\ Powerlimitconstraints & (6) \end{cases}$$

1) SIC constraints: The arrangement of conditions that cause the mutual SIC method conceivable from the data theory viewpoint, for example, the conditions on reachable rates at the separate client's levels.

2) Power multiplexing constraints (PMC): The arrangement of conditions that cause the mutual SIC method feasible from a practical execution viewpoint, for example, the conditions on the recieved signals, powers at the particular client's levels.

Leave Si alone the sign of client I ∈ {1, 2, 3}. As indicated by the received signals powers at the separate clients levels the SIC guideline, if signals S1, S2,and S3 are to be decoded in a specific order at the degree of one of the clients, at that point the significant power of S1 at the level of that client should be more prominent than that of S2 and S3 joined, and the power level of S2 should be more noteworthy than that of S3. This ensures SIC strength since each sign is guaranteed to be the predominant sign during its decoding.

3)Power limit constraints: The most extreme aggregate sum of transmit power accessible at the level of the RRHs.

With these constraints we will provide power to each user. Since we are sending the sub carriers simutaneously it is difficult to calculate the channel state information. Hence in previous work it is not considered. Here without considering piolet contamination we estimate CSI.

III. ESTIMATION OF CHANNEL STATE INFORMATION METHODS

Users send their channel state information (CSI) to RRHs, then baseband units collect these CSI and share them with other RRH. Since the influence of imperfect channel estimation usually considering perfect CSI. So in this work, we are calculating CSI with the LS method & MMSE methods.

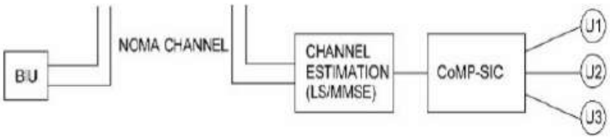


Fig. 5: Block diagram for NOMA system with channel state information methods.

To know channel properties of communication link channel state information required. This describes the combined effect of fading, scattering and power decay. CSI in NOMA is quite difficult to do. In this paper, we are doing LS & MMSE methods to get channel state information.

To estimate the channel, we using a reference signal called pilot signals. It can be written as

$$Y_g = X_g H_g + \lambda_g (7)$$

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

A. Least Square (LS) method

To limit the square distance between the original signal and the received signal we are using the channel least square estimator. The least-square estimates of the channel at the pilot subcarriers yielded [9] can be gotten by the accompanying condition

$$H_{g(LS)} = X_g^{-1} Y_g (8)$$

Where $H_{p(LS)}$represents the least square estimategot over the pilot subcarriers.In this system we are not considering noise and computational complexity is low. The main drawback of this system is it has high mean square error value and whenever data change happened matrix inversion is required.

B. Mean Minimum Square Error method

MMSE estimate of $H_{(MMSE)}$ for the channel and AWGN is not correlated is given by [10],

$$H_{(MMSE)} = R_{Hg\,Xg} R^{-1}_{Xg\,Xg} X_g (9)$$

$$R_{Hg\,Xg} = E\{H_g X_g^H\} = R_{HgHg} Y_g^H \qquad (10)$$

Where,

$$R_{Xg\,Xg} = E\{X X_g^H\} = Y_g R_{HgHg} Y_g^H + \sigma_n^2 I_{Ng} (11)$$

are the cross covariance matrix between H_g and $X_g$and auto-covariance matrix of X_g. R $_{HgHg}$is auto-covariance matrixof H_g $\sigma_n^2$is the noise-variance. In this channel noise is considering hence gives better result than LS method. But its computational complexity is high.

IV. SIMULATION RESULTS

A. Estimation of Channel State Information

In this Fig. 6, we have calculated channel state information of NOMA with the help of LS and MMSE methods. For this, we have calculated Bit error rate (BER) and SNR for both techniques with different number of transmitters and receivers (Nt and Nr).

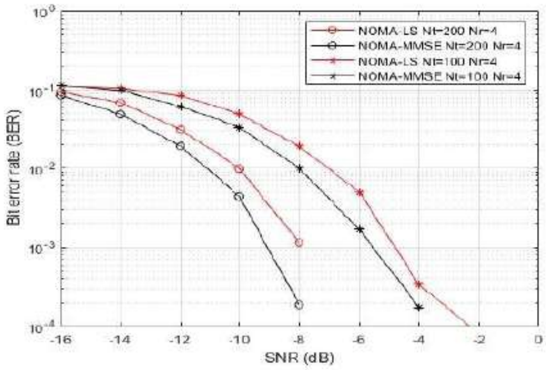


Fig. 6: Channel state information of NOMA system

From this, it is clear that when number of transmitters increase BER decreases. Here, we considered the number of the transmitter as 100 or 200. When we compared this, in both cases, the MMSE bit error rate is less than that of the LS method.

B. Estimation of Mean square error

Let $\check{Y} = g(X)$ be an estimator of random variable Y, then

$$E[(Y - \check{Y})^2] = E[(Y - g(X))^2] \qquad (12)$$

is the mean squared estimator.

The MMSE estimator of Y has the lowest MSE among all the other estimators and it is given by,

$$\check{Y}_{MMSE} = E[Y\backslash X], \qquad (13)$$

The comparison between LS and MMSE NOMA techniques mean square error is as shown in figure 7. And from this, it is clear that MMSE has the lowest MSE value compared with the LS method.

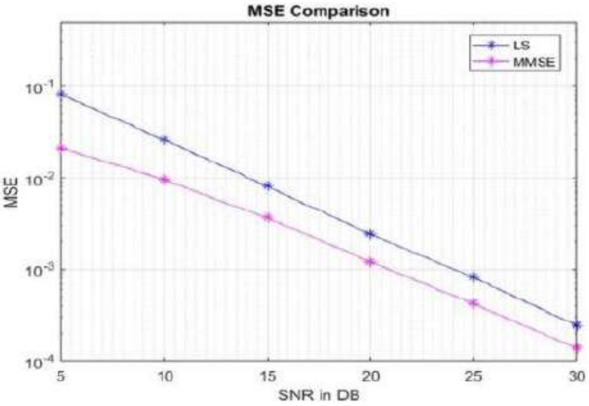


Fig. 7 : Comparison of MSE for LS and MMSE methods

V. CONCLUSION

In all the previous work, a known Channel State Information Estimation (CSI) is considered which is not practically possible.In this paper, we derive the solution to estimate channel state information methods of NOMA system by using both Least Square (LS) and Mean Minimum Square Error (MMSE) methods. But piolet contamination is not considered in this. So this system can be upgraded by considering piolet contamination. This system can be extended to more users. When the number of users increased,spectral efficiency also increased.From the simulation result, it is clear that the spectral efficiency of three user systems is more than that of two user systems. Channel estimation can be done by the use of neural network and Maximum Likely hood method and can minimize Symbol Error Rate

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