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Spectrum Efficiency and BER Analysis of Massive Systems with CE Equalizers Technique

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Abstract: The fifth generation of mobile communication systems (5G) promises unprecedented levels of connectivity and quality of service (QoS) to satisfy the incessant growth in the number of mobile smart devices and the huge increase in data demand. One of the primary ways 5G network technology will be accomplished is through network densification, namely increasing the number of antennas per site and deploying smaller and smaller cells. Massive MIMO, where MIMO stands for multiple-input multiple-output, is widely expected to be a key enabler of 5G. This technology leverages an aggressive spatial multiplexing, from using a large number of transmitting/receiving antennas, to multiply the capacity of a wireless channel. The access points (Aps) are connected, through a fronthaul network, to a central processing unit (CPU) which is responsible for coordinating the coherent joint transmission. Such a distributed architecture provides additional macro-diversity, and the co-processing at multiple APs entirely suppresses the inter-cell interference. Depending on slow/fast channel fading conditions, several authors suggested adaptive LMS, RLS and NLMS based channel estimators, which either require statistical information of the channel or are not efficient enough in terms of performance or computations. In order to overcome the above effects, the work focuses on the QR-RLS based channel estimation method for Massive MIMO systems with different modulation scheme.

***Index Terms* – Massive MIMO, Channel State Information, Square Root-Recursive Least Square (QR-RLS), QAM Modulation**

I. Introduction

MIMO technology has been a topic of interest for the past two decades and MU-MIMO has made its way into standards such as 4G LTE and IEEE 802.11 (WiFi). Massive MIMO is a variant of MU-MIMO with the potential to offer significantly higher spectral and energy efficiencies at low computational complexities, making it one of the enabling technologies for 5G communication systems. In a classic communication system, the information to be transmitted is modulated onto a single carrier. In wireless communication, there is a huge demand for high data rate especially for multimedia applications. Data Transfer Rate (DTR) is the measure of speed of information from the source to the destination. High data rate consumes wide bandwidth. The present day demand for high data rate at lower bandwidth can be achieved by use of Orthogonal Frequency Division Multiplexing (OFDM) (Sinem 2002). The data rate which can be achieved is over 100 Mbps which is far high compared to data rate of other techniques. In a practical scenario, the transmitted signal undergoes fading and addition of Gaussian noise at the receiver. For retrieval of information, it is required to know the channel correlation functions. The randomness of the wireless channel complicates the prediction of channel correlation functions. Therefore it is desirable to have an estimator which is robust to the mismatches between the assumed and the actual channel correlation functions. The time varying nature of the channel adds additional cost to estimator design. The objective therefore is to design an optimal channel estimation algorithm with minimum computational complexity.

II. CHANNEL ESTIMATION

Channel in communications refers to the medium used to convey information from a sender to a receiver. A channel can be modeled to calculate the physical processes which modify the transmitted signal. For example, in wireless communications, the channel can be modeled by calculating the reflection of every object in the environment. A sequence of random numbers might also be added to simulate external interference and/or electronic noise in the receiver.

Statistical and physical modeling can be combined. For example, in wireless communications, the channel is often modeled by a random attenuation of the transmitted signal, followed by additive noise. The attenuation term is a simplification of the underlying physical processes and captures the change in signal power over the course of the transmission. The noise in the model captures external interference and/or electronic noise in the receiver.

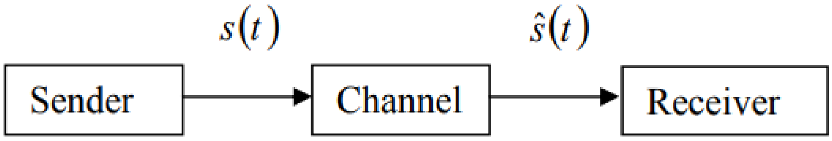

Figure 1: Block diagram of communication system

III. PROPOSED METHODOLOGY

The MIMO-OFDM device modified into applied with the useful resource of MATLAB/SIMULINK. The execution device is binary facts this is modulated the use of QAM and mapped into the constellation elements.

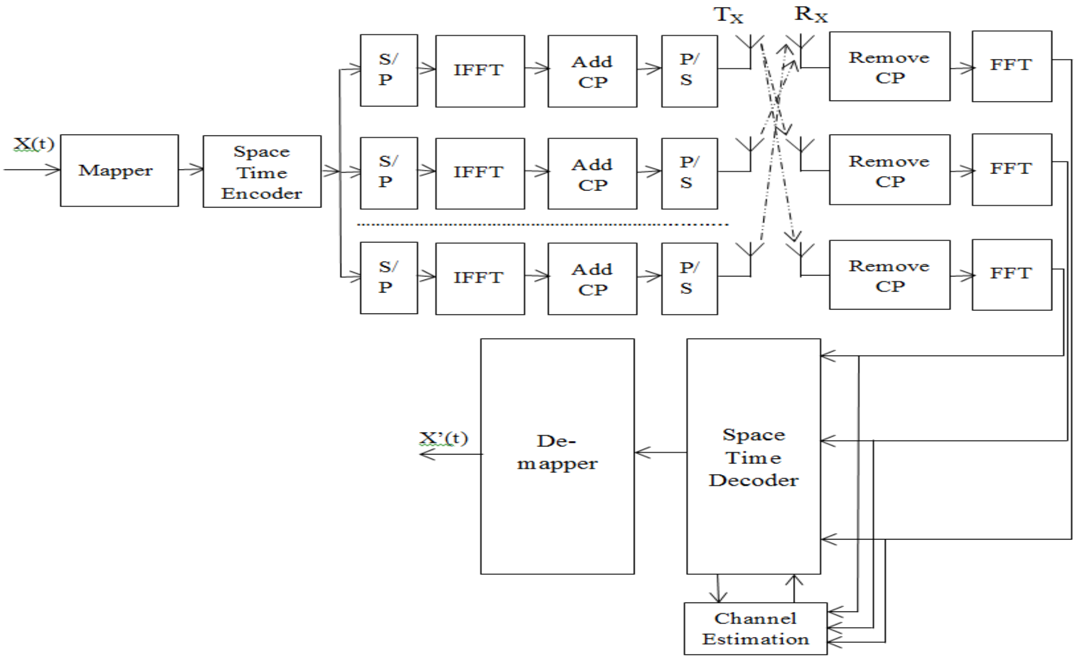

Figure 2: Massive MIMO System Models with Channel Estimation Technique

The virtual modulation scheme will transmit the records in parallel by means of manner of assigning symbols to every sub channel and the modulation scheme will determine the phase mapping of sub-channels thru a complex I-Q mapping vector show in figure 2. The complicated parallel facts stream must be converted into an analogue signal this is suitable to the transmission channel.

The complicated parallel facts stream has to be transformed into an analogue sign that is suitable to the transmission channel. It is performed to the cyclic prefix add to the baseband modulation signal because the baseband signal is not overlap. After than the signal is splitter the two or more part according to the requirement.

Square Root Recursive Least Square (QR-RLS) Algorithm

A QR-RLS based MIMO-OFDM channel estimation is proposed. Which uses givens rotation based QR factorization for estimator updating. Channel estimation is a center issue for recipient plan in remote correspondences frameworks. Since it is unimaginable to expect to quantify each remote direct in the field, it is critical to utilize preparing arrangements to appraise channel parameters, for example, constrictions and deferrals of the proliferation way. Since in most UWB recipients associate the got flag with corresponded a predefined format flag, an earlier learning of the remote channel parameters is important to foresee the state of the layout flag that matches the got flag.

Mathematical Equation

Be that as it may, because of the wide data transfer capacity and diminished flag vitality, UWB beats experience extreme heartbeat twisting.

Consider the received signal at q^{th} receive antenna represented in matrix form as

$$Y(n) = (U(n).H(n)) + V(n) \tag{1}$$

The posteriori error is given by the difference between the received preamble symbol and its corresponding estimate at time n on q^{th} receiving antenna

$$e(q,n) = y(q,n) - \tilde{y}(q,n) \tag{2}$$

$$e(q,n) = y(q,n) - X_{pre}(n)\tilde{H}_q \tag{3}$$

Where $\tilde{H}$ has the same dimensionality as H. The weighted Square-root error at time n is given by

$$e(q,n)=\sum_{i=0}^{n}\lambda^{n-i}\left(\left|e(q,i)\right|\right)^{2} \tag{4}$$

Where λ is weigh factor, whose value lies between (0, 1) depending on channel fading conditions is present. Solution of the above equation gives the optimum value for the estimated channel coefficients H at time n. The optimum solution

$$H_q(n)=R^{-1}{}_X(n)\times R_{Yqx}(n) \tag{5}$$

Where $R_{Yqx}(n)$ is the autocorrelation matrix of the preamble signal, $R^{-1}{}_X(n)$ is the cross correlation matrix between received signal and the preamble signal at time n.

IV. SIMULATION RESULT

MATLAB simulations are performed for various combinations of transmitted and received antenna in massive MIMO system. Simulation experiments are conducted to evaluate the SNR verse bit error rate (BER) performance of the proposed QR-RLS based channel estimation with different modulation technique i.e. QAM-16, QAM-32 and QAM-64 for 8×8 system is shown in figure 3. For different value of SNR, the implemented QR-RLS based channel estimation for 8×8 system shows BER reduction performance.

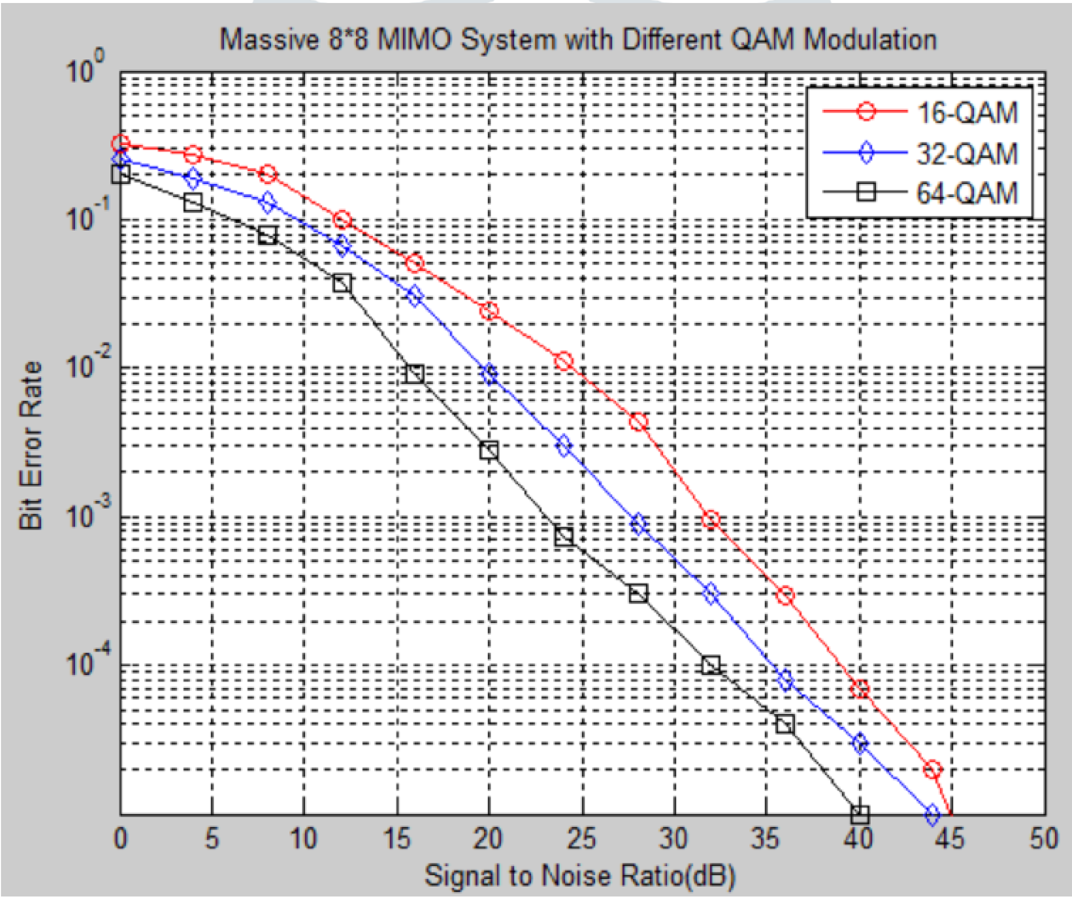

Figure 3: BER vs SNR for Massive 8×8 System with QR-RLS based Channel Estimation Technique

Simulation experiments are conducted to evaluate the SNR VS BER performance of the proposed algorithm 16×16 system is shown in figure 4.

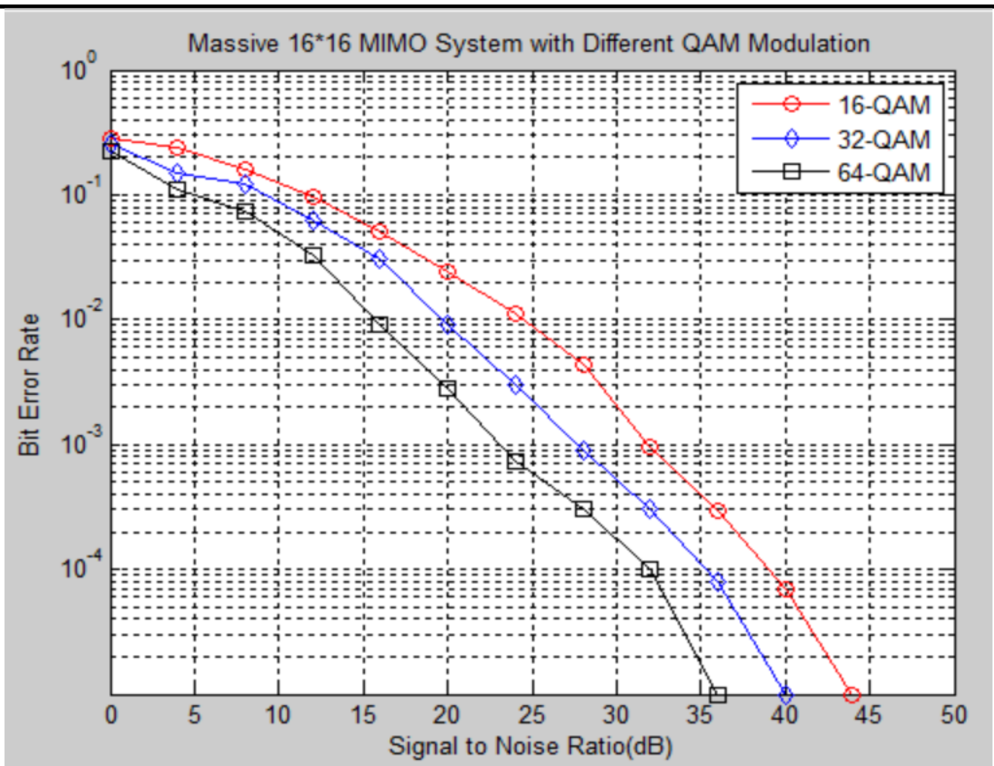

Figure 4: BER vs SNR for Massive 16×16 System with QR-RLS based Channel Estimation Technique

Simulation experiments are conducted to evaluate the SNR VS BER performance of the proposed algorithm 32×32 system is shown in figure 5.

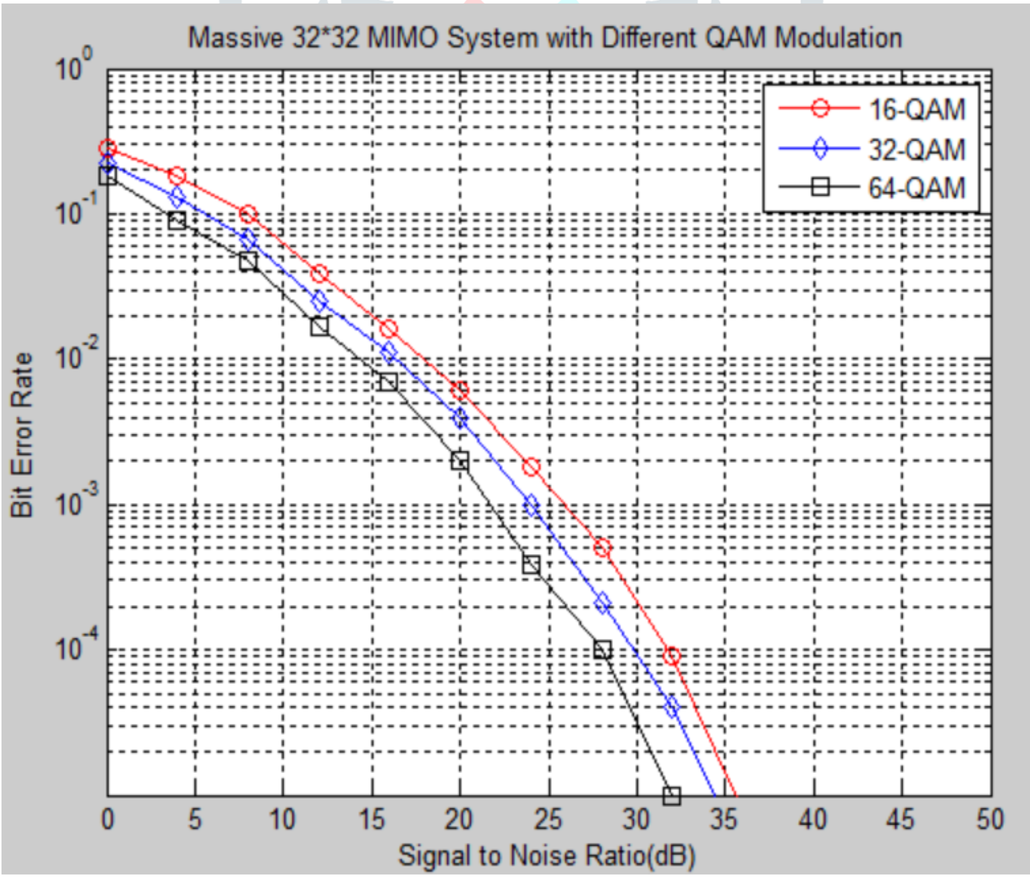

Figure 5: BER vs SNR for Massive 32×32 System with QR-RLS based Channel Estimation Technique

Simulation experiments are conducted to evaluate the SNR verse spectrum efficiency performance of the proposed QR-RLS based channel estimation with different modulation technique i.e. QAM-16, QAM-32 and QAM-64 for 8×8 system is shown in figure 6.

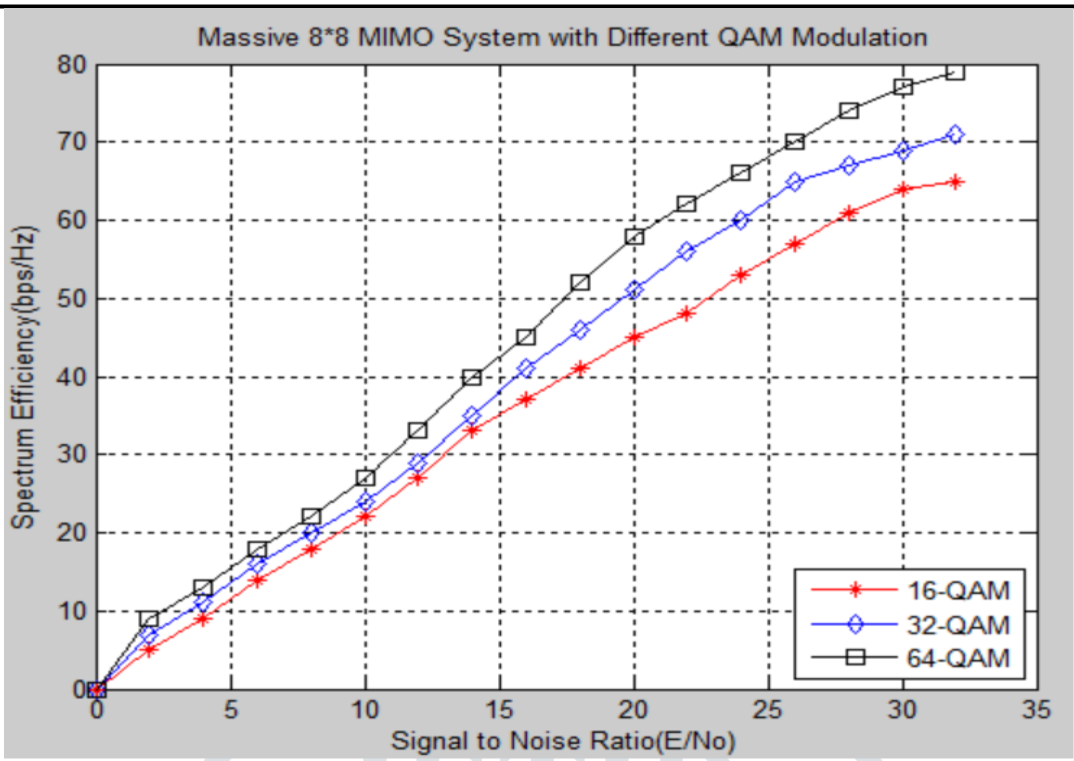

Figure 6: Spectrum Efficiency vs SNR for Massive 8×8 System with QR-RLS based Channel Estimation Technique

V. CONCLUSION

Wireless channel in a physical scenario has fading characteristics. Additive noise is added to the signal at the receiver end. It is therefore desirable to have an estimator which is robust to mismatches between the assumed and the actual channel correlation functions. The thesis discusses the basic mathematics of various estimators like least square estimator, minimum mean square estimator, estimator and Minimax. The medium considered is a wireless channel modelled as Rayleigh distribution with additive white Gaussian noise. Simulation result is clear that the 32×32 transmitter and receiver antenna is best performance compared to 16×16, 8×8 transmitter and receiver antenna.

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