Optimization Result Analysis of Massive Systems with Raptor Encoder and 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.

Keywords— Massive MIMO, Channel State Information, Square Root-Recursive Least Square (QR-RLS), QAM Modulation

I. INTRODUCTION

Error detection and correction helps in transmitting data in a noisy channel to transmit data without errors. Error detection refers to detect errors if any received by the receiver and correction is to correct errors received by the receiver.

Different errors correcting codes are there and can be used depending on the properties of the system and the application in which the error correcting is to be introduced [14]. Generally error correcting codes have been classified into block codes and convolutional codes. The distinguishing feature for the classification is the presence or absence of memory in the encoders for the two codes.

To generate a block code, the incoming information stream is divided into blocks and each block is processed individually by adding redundancy in accordance with a prescribed algorithm. The decoder processes each block individually and corrects errors by exploiting redundancy.

In a convolutional code, the encoding operation may be viewed as the discrete–time convolution of the input sequence with the impulse response of the encoder. The duration of the impulse response equals the memory of the encoder. Accordingly, the encoder for a convolutional code operates on the incoming message sequence, using a sliding window equal in duration to its own memory. Hence in a convolutional code, unlike a block code where code words are produced on a block-by-block basis, the channel encoder accepts message bits as continuous sequence and thereby generates a continuous sequence of encoded bits at a higher rate [14].

An error-correcting code (ECC) or forward error correction (FEC) code is a system of adding redundant data, or parity data, to a message, such that it can be recovered by a receiver even when a number of errors (up to the capability of the code being used) were introduced, either during the process of transmission, or on storage. Since the receiver does not have to ask the sender for retransmission of the data, a back-channel is not required in forward error correction, and it is therefore suitable for simplex communication such as broadcasting. Error-correcting codes are frequently used in lower-layer communication, as well as for reliable storage in media such as CDs, DVDs, hard disks, and RAM.

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.

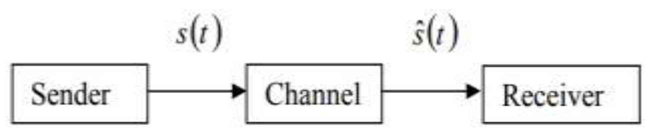

Figure 1: Block diagram of communication system

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.

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.

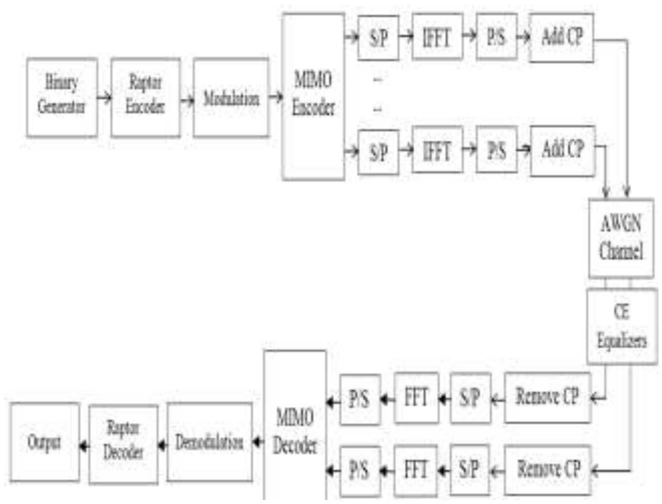

Figure 2: Massive MIMO System Models with Channel Estimation Technique

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

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

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.

Raptor Encoder

The results of the previous section imply that LT-code cannot be encoded with constant cost if the number of collected output symbols is close to the number of input symbols. In this section, we will present a different class of Fountain codes. One of the many advantages of the new construction is that it allows for encoding and decoding with constant cost, as we will see below.

The reason behind the lower bound of for the cost of LT-codes is the information-theoretic lower bound of Proposition. The decoding graph needs to have an order of edges in order to make sure that all the input nodes are covered with high probability. The idea of Raptor coding is to relax this condition and require that only a *constant fraction* of the input symbols be recoverable. Then the same information-theoretic argument as before shows only a linear lower bound for the number of edges in the decoding graph.

There are two potential problems with this approach: 1) The information-theoretic lower bound may not be matchable with an algorithm, and 2) we need to recover all the input symbols, not only a constant fraction.

The second issue is addressed easily: we encode the input symbols using a traditional erasure correcting code, and then apply an appropriate LT-code to the new set of symbols in a way that the traditional code is capable of recovering all the input symbols even in face of a fixed fraction of erasures. To deal with the first issue, we need to design the traditional code and the LT-code appropriately.

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.

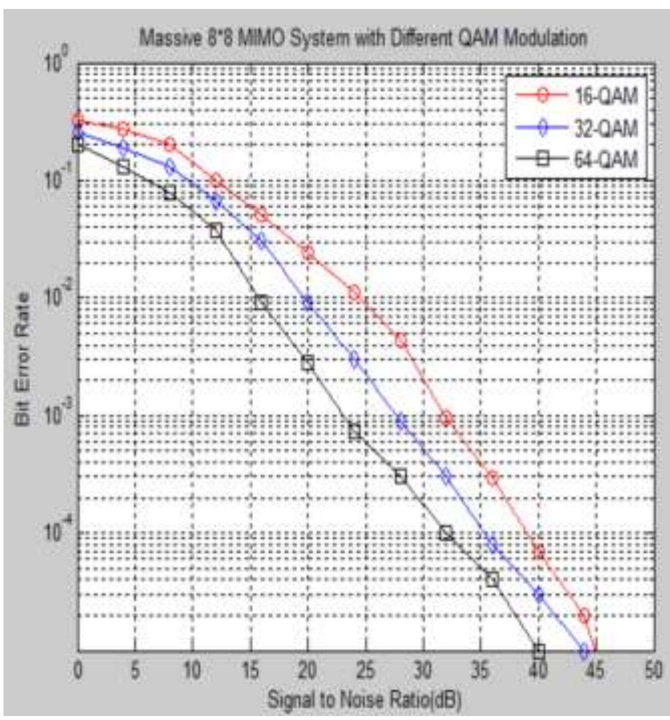

Figure 3: BER vs SNR for Massive 8×8 System with QR-RLS based Channel Estimation Technique

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

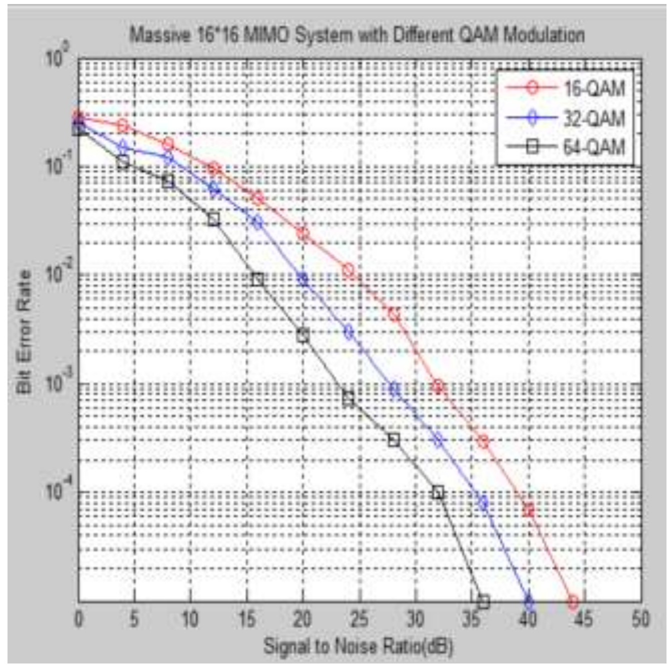

Figure 4: BER vs SNR for Massive 16×16 System with QR-RLS based Channel Estimation Technique

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

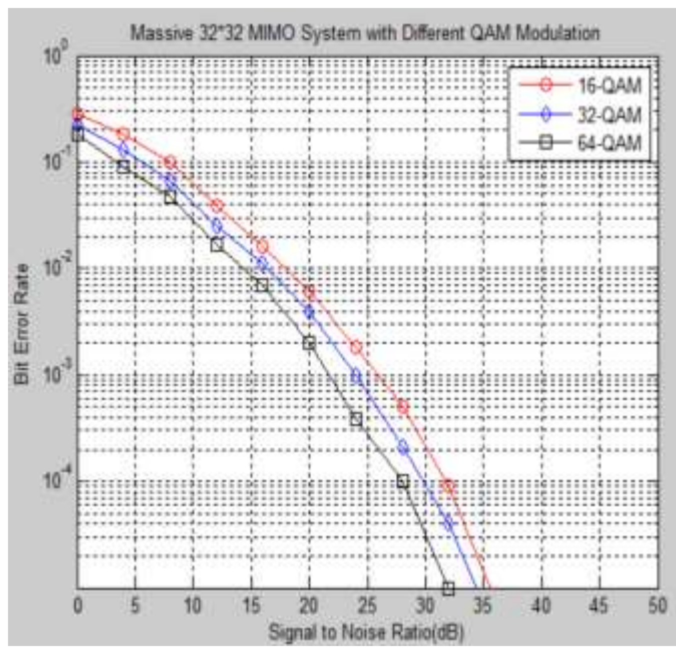

Figure 5: BER vs SNR for Massive 32×32 System with QR-RLS based Channel Estimation Technique

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.

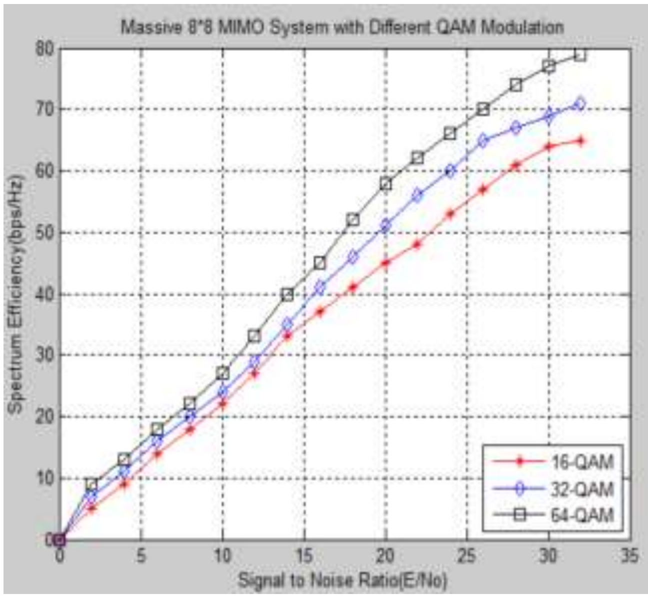

Figure 6: Spectrum Efficiency vs SNR for Massive 8×8 System with QR-RLS based Channel Estimation Technique

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.

REFRENCES

[1] Aravinda Babu Tummala and Deergha Rao Korrai, "Performance Analysis of LDPC Coded Massive MIMO-OFDM System", International Conference for Emerging Technology (INCET), IEEE 2020.

[2] H. Q. Ngo A. Ashikhmin H. Yang E. G. Larsson T. L. Marzetta "Cell-free massive MIMO versus small cells" IEEE Trans. Wireless Communication vol. 16 no. 3 pp. 1834-1850 Mar. 2017.

[3] Huang A. Burr "Compute-and-forward in cell-free massive MIMO: Great performance with low backhaul load" Proc. IEEE Int. Conf. Communication (ICC) pp. 601-606 May 2017.

[4] H. Al-Hraishawi, G. Amarasuriya, and R. F. Schaefer, "Secure communication in underlay cognitive massive MIMO systems with pilot contamination," in In Proc. IEEE Global Communication Conf. (Globecom), pp. 1–7, Dec. 2017.

[5] V. D. Nguyen et al., "Enhancing PHY security of cooperative cognitive radio multicast communications," IEEE Trans. Cognitive Communication and Networking, vol. 3, no. 4, pp. 599–613, Dec. 2017.

[6] R. Zhao, Y. Yuan, L. Fan, and Y. C. He, "Secrecy performance analysis of cognitive decode-and-forward relay networks in Nakagami-m fading channels," IEEE Trans. Communication, vol. 65, no. 2, pp. 549–563, Feb. 2017.

[7] W. Zhu, J. and. Xu and N. Wang, "Secure massive MIMO systems with limited RF chains," IEEE Trans. Veh. Technol., vol. 66, no. 6, pp. 5455–5460, Jun. 2017.

[8] R. Zhang, X. Cheng, and L. Yang, "Cooperation via spectrum sharing for physical layer security in device-to-device communications under laying cellular networks," IEEE Trans. Wireless Communication, vol. 15, no. 8, pp. 5651–5663, Aug. 2016.

[9] K. Tourki and M. O. Hasna, "A collaboration incentive exploiting the primary-secondary systems cross interference for PHY security enhancement," IEEE J. Sel. Topics Signal Process., vol. 10, no. 8, pp. 1346–1358, Dec 2016.

[10] T. Zhang et al., "Secure transmission in cognitive MIMO relaying networks with outdated channel state information," IEEE Access, vol. 4, pp. 8212–8224, Sep. 2016.

[11] Y. Huang et al., "Secure transmission in spectrum sharing MIMO channels with generalized antenna selection over Nakagami-m channels," IEEE Access, vol. 4, pp. 4058–4065, Jul. 2016.

[12] Y. Deng et al., "Artificial-noise aided secure transmission in large scale spectrum sharing networks," IEEE Trans. Communication, vol. 64, no. 5, pp. 2116–2129, May 2016.

[13] J. Zhu, R. Schober, and V. K. Bhargava, "Linear precoding of data and artificial noise in secure massive MIMO systems," IEEE Trans. Wireless Communication, vol. 15, no. 3, pp. 2245–2261, Mar. 2016.

[14] K. Guo, Y. Guo, and G. Ascheid, "Security-constrained power allocation in MU-massive-MIMO with distributed antennas," IEEE Trans. Wireless Commun., vol. 15, no. 12, pp. 8139–8153, Dec. 2016.

[15] Supraja Eduru and Nakkeeran Rangaswamy, "BER Analysis of Massive MIMO Systems under Correlated Rayleigh Fading Channel", 9th ICCCNT IEEE 2018, IISC, Bengaluru, India.