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Channel State Estimation and Interference Elimination for LTE-A Networks

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ABSTRACT : In MIMO-LTE-A Networks, maximum-likelihood receiver structure can suppress more than one interfering layers when the user terminal receiver contains only two antennas. Also, the channel state should be estimated for correctly recovering the transmitted information. Hence in this paper, we propose to design a Channel Quality Estimation with Parallel Inter Carrier Interference (ICI) cancellation technique for MIMO-LTE-A networks. Initially the maximum-likelihood detection – interference suppression (MLD-IS) scheme is applied to suppress the interfering links. Then in ICI cancellation method, a parallel interference cancellation (PIC) scheme and decision statistical combining (DSC) is utilized to cancel the ICI and improve data symbol detection. The channel state is estimated using Approximate Linear Minimum Mean Square Error (ALMMSE) method based on the best-M Channel Quality Indicator (CQI) and Pre-coding Matrix Indicator (PMI) feedbacks. Simulation results show that the proposed technique reduces the computational process and the complexity.

I. INTRODUCTION

1.1 LTE-A networks

Long Term Evolution Advanced (LTE-A) is a mobile communication standard. It is a major enhancement of Long Term Evolution (LTE) standard. It was submitted as a candidate 4G system to ITU-T by satisfying the IMT-Advanced standard needs. The 3rd Generation Partnership Project (3GPP) standardized this. LTE is proposed by the 3GPP to evolve towards 4G. LTE-Advanced provide high data rate services of 100 Mbps for high mobility and 1Gbps for low mobility conditions. 3GPP organization developed LTE standard with high data rate and mobility, and low latency and packet optimized radio access. LTE uses single-carrier frequency division multiple access (FDMA) for the uplink and orthogonal FDMA in downlink. The main technology components in LTE-A include bandwidth extension, advanced MIMO schemes, coordinated multipoint (CoMP) techniques and relay nodes [1] [2] [3].

In LTE-A for Downlink (DL) data transmission, Physical Downlink Shared Channel (PDSCH), Control Channel and Common Control Physical Channel (CCPCH) were used and for Uplink (UL) data transmission, two UL physical channels are used: Physical Uplink Shared Channel (PUSCH) and Physical Uplink Control Channel (PUCCH) [15].

1.2 Interference Cancellation in LTE-A networks

In modern wireless communication systems, the most important issues are co-channel interference. During recent decades, the interference cancellation and suppression problem has got attention in academia and wireless industry. Co-channel interference in LTE systems is solved using interference mitigation techniques operating at the network side or at the terminal receivers. In LTE Rel-8, by exchanging a power allocation message between cooperating nodes through a standardized backhaul interface, intercell interference coordination is done in the frequency domain. Using a bitmap, that message is signaled in which each bit value indicates the corresponding physical resource block pair has transmit power above a certain threshold. After receiving the power allocation message, the neighboring node can obtain this information to make its own scheduling decisions.

Advanced receivers at UE side can benefit from the knowledge about interfering transmissions under possible coordination by the network for solving the co-channel interference from inter-cell or co-scheduled intra-cell users. Traffic channel and control channel and cell-specific reference signals apply the advanced interference cancellation and mitigation. Evaluation of the gain and feasibility of those diverse advance receivers offers the guidance for the methods for balancing the performance improvements and the UE implementation complexity and the increased signaling overhead in the air-interface [16].

1.3 Channel estimation in LTE-A networks

In mobile communication systems, channel estimation is significant part of receiver designs used. For correctly recovering the transmitted information, the effect of the channel on the transmitted information should be calculated. The estimation of channel effects depends on an underlying model of the radio propagation channel. The receiver can precisely recover the transmitted information as long as it maintains the records of varying radio propagation channels.

Various types of channel estimation techniques are Pilot assisted channel estimation, Least Square Channel Estimation, Estimation with Decision Feedback, Modified Wiener Filter and Neural Network Channel Estimation [17].

In pilot-assisted channel estimation, statistical estimation of the channel at OFDM tones that has reference symbols including Squares (LS) and Minimum Mean Squares (MMSE) estimates is determined. For the estimation of the channel effects on the transmitted signal, different pilots assisted channel estimation schemes can be employed [14].

Square error, frequency-scheduling, throughput, noise and interference are the main concerns in channel quality estimation [12] [13] whereas fast time-varying channel environment and path loss are the issues of channel estimation [10] [11].

1.4 Problem statement and Objectives

In LTE-A systems there exists some of the drawbacks which has to be solved, in [4] the adaptive approach experience receiver complexity. In [5] the density in the cluster and the partially shared spectrum may cause extra interferences. In [6] the spectrum efficiency is less. In [7] there occurs computational complexity and performance loss compared to other schemes. In [8] the cell edge user throughput is less. In [10] the group id difference in adjacent cell should be made larger in the case of cell deployment topology. In [11] and [13] there occurs channel estimation error and minimum square error. The relay nodes used in [20] exhibits interference in additional back haul link.

So from the above problems in order to overcome the interference cancellation and to provide efficient channel estimation, the following functionalities should be considered:

- carrier aggregation
- coordinated multi point (CoMP)
- spectrum efficiency

The carrier aggregation enables multiple LTE carriers to be used together to provide the high data rates. The coordinated multipoint is used to send and receive data to and from several points to ensure the optimum performance even at cell edges. By the spectrum efficiency the frequency of the spectrum can be maintained.

Along with these functionalities the channel quality estimation properties such as throughput, noise and interference and performance delivery ratio should also be considered.

1.5 Problem Identification

So from the above objective, a maximum-likelihood detection interference suppresser (MLD-IS) scheme has been proposed to suppress more than one dominant interfering links [8]. For received signal model, the cell-edge user equipment with one dominant interfering station and single-layer transmission is considered. When the user terminal receiver has only two antennas, this maximum-likelihood receiver structure can suppress more than one interfering layers.

However only a single layer transmission is considered in this scheme and also the cell edge user throughput is less. The cell-edge user throughput gain becomes more remarkable and increases up to 23% if the processing capability of the MLD-IS is further extended up to three layers (i.e., beyond the number of receiver antennas). Also, to recover the transmitted information correctly, the channel estimation is not used.

In this paper, we propose to design a Channel Quality Estimation with Parallel Inter Carrier Interference (ICI) cancellation technique for MIMO-LTE-A networks.

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II. LITERATURE REVIEW

Heunchul Lee et al [4] have proposed a new adaptive approach in which the combining parameter is adjusted adaptively based on the instantaneous interference-to-signal ratio for exploiting the probabilistic behavior of the optimal combining ratio over the interference-to-signal ratio. To verify the prediction accuracy of the link abstraction method, the link-level simulation results are provided. Moreover, they use the proposed link abstraction model as a link-to-system interface mapping in system-level simulations to demonstrate the performance of the IAC receiver in interference-limited LTE systems. However there occurs receiver complexity.

Shi Cheng and Ravi Narasimhan [7] have proposed a new soft interference cancellation (SIC) receiver for the SC-FDMA MIMO uplink in the LTE and LTE-advanced systems. Using the feedback from the decoder to cancel interfering spatial streams, the receiver operates in an iterative manner between the equalizer and decoder. The receiver cancels inter-symbol interference of the desired stream caused by frequency selective fading channel that decreases the well-known "noise enhancement" effect in SC-FDMA. Parallel SIC and serial SIC are presented as the two types of structures. To improve the performance of the SIC receiver, an iterative channel estimation method is introduced. During equalization, feedback reliability metrics are defined and applied for avoiding catastrophic error propagation. By the help of proper reliability metrics, hard-slicing on feedback symbol generation is utilized to save computational complexity with very small performance loss compared with soft slicing.

Alexei Davydov et al [8] have been proposed the linear interference rejection combining (IRC) receiver to address the interference issue in LTE-A systems. Through simple beam forming on the antenna elements of the receiver that is calculated using the estimated interference covariance matrix, inter-cell interference suppression in the IRC receiver is provided. A maximum-likelihood detection (MLD) scheme is used for suppressing more than one dominant interfering links. MLD receiver structure improves the cell-edge user throughput by approximately 23% compared with the baseline linear IRC receiver. However, there is a lack of validation results for the proposed scheme.

A. Omri et al [9] have proposed a channel estimator using neural network for LTE uplink that considers multiuser SC-FDMA uplink transmissions with doubly selective channels. For estimating the unknown channel response at non-pilot sub-carriers, this channel estimation method uses knowledge of pilot channel properties. Neural network estimator adapts to the channel variations. It then estimates the channel frequency response. This method has better performance, in terms of complexity and quality, compared with the conventional methods such as least square (LS), MMSE and decision feedback. This is more robust at high-speed mobility. However there occurs complexity in the scheme.

Shun-Fang Liu and Pei-Yun Tsai [10] have proposed a new neighbor cell search algorithm for LTE/LTEA systems. A non-coherent scheme is proposed that uses the similarity of channel responses at adjacent subcarriers. This can be performed to improve the interference problem in channel estimation for coherent SSS detection in the conventional neighbor cell search approaches. The neighbor cell search procedure includes both PSS and SSS detection and combats different carrier frequency offsets that the home cell signal and the neighbor cell signal may suffer. The home cell synchronization signals' removal converts the neighbor cell PSS and SSS into new sequences for recognition, respectively. They show that partial correlation can well detect the neighbor cell sector ID and group ID through the new sequences by examining the cross-correlation properties of the new sequences. This algorithm has good detection results and outperforms the conventional coherent approaches. However, from the cell deployment topology in the group ID difference of adjacent cells is not big; hence, the worst case is seldom encountered.

Xingyu Xia et al [11] have proposed an improved sounding reference signal (SRS) design that achieves minimum interference between different reference signals. In LTE uplink, it is backwards compatible with the SRS. An improved SRS channel estimation is proposed for multiple transmit antennas. SRS design leads to less channel estimation error. SRS channel estimation can reach similar accuracy to exponential power delay profile channel estimation, with low complexity. However, there occurs a little larger channel estimation error.

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Kazuki TAKEDA et al [12] have presented a model channel estimation error of LTE-A uplink assuming the use of demodulation RS (DMRS) introduced in LTE-A by considering the property of DMRS. System-level simulation evaluates the impact of channel estimation error on CoMP operation. However as much possible CoMP gain is not achieved.

Muntadher Qasim Abdulhasan et al [13] have proposed linear minimum mean square error (LMMSE) and approximate linear minimum mean square error (ALMMSE), which are the two different channel estimation schemes. These schemes are used to calculate channel quality indicator and precoding matrix indicator in the 3GPP-LTE fast fading channel. The estimation error is reduced with small reduction in throughput using a low-complexity ALMMSE. Therefore, this method is recommended to be used when the network is not fully loaded for better tradeoff related to MSE and throughput by considering the fixed and mobility scenarios. Hence, reliable transmission will be targeted. However, there is a big gap in the average throughput of ALMMSE, which is around 3 Mbit/s at high SNR. It gives a minimum square error.

Marco Maso et al [19] have proposed a novel cognitive interference alignment-based scheme to protect the macro cell from cross-tier interference while mitigating the co-tier interference in the second tier. The optimal precoder found using distributed one-shot strategy increases the spectral efficiency of the link between each SBS and its served user equipment. Numerical findings reveal that no negligible spectral efficiency enhancements with respect to traditional time division multiple access approaches at any signal-to-noise ratio regime. Moreover, this scheme exhibits significant robustness to channel estimation errors by attaining remarkable results for the imperfect CSI case and yielding consistent performance enhancements to the network.

LI Bo et al [20] have proposed an interdomain cooperative traffic-balancing scheme reduces the effective resource cost and avoids the co-channel interference in multidomain Het-Net. The conception of multi-domain in Het-Net is established. The co-channel interference is incorporated into the traffic balancing scheme. The traffic-balancing issue is modeled as a multi-domain traffic resource optimization problem to reduce the effective resource cost. The authors design the detailed implementation of the traffic-balancing scheme. In the numerical evaluation, the genetic algorithm is used as an optimization method. However the relay nodes cause additional interference at backhaul link.
Neda Aboutorab et al [21] have proposed iterative channel estimation and inter carrier interference cancellation method for highly mobile users in LTE systems. The wireless channel is estimated by using pilot symbols, estimates of the data symbols, and Doppler spread information at the receiver. This scheme outperforms the best-known schemes for high Doppler spreads. However, using preamble reduces the throughput efficiency of the system.

III. PROPOSED SOLUTION

3.1 Overview

In this paper, we propose to design a Channel Quality Estimation with Parallel Inter Carrier Interference (ICI) cancellation technique for MIMO-LTE-A networks. Initially the maximum-likelihood detection–interference suppression (MLD-IS) scheme is applied to suppress the interfering links. Then in ICI cancellation method, they use a simplified parallel interference cancellation (PIC) scheme along with decision statistical combining (DSC) to cancel the ICI and improve data symbol detection. The ICI component on every sub carrier is calculated and it is subtracted from the receiver signal, for cancelling the ICI. The channel state is estimated using Approximate Linear Minimum Mean Square Error (ALMMSE) method based on the best-M Channel Quality Indicator (CQI) and Pre-coding Matrix Indicator (PMI) feedbacks. Here User Equipment (UE) will receive the signal and estimate the channel condition. The estimated channel parameters, such as the Signal to Interference plus Noise ratio (SINR), were mapped into discrete values to represent the index of CQI. By this method an accurate channel status is provided.

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Figure-1 shows the block diagram of the proposed architecture.

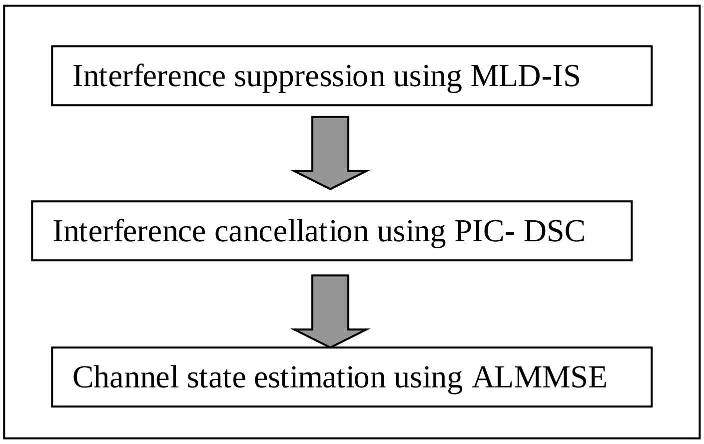

Figure-1 Block Diagram of the Proposed Architecture

3.2 Suppressing Interfering links

Initially, a maximum-likelihood detection – interference suppression (MLD-IS) scheme is applied to suppress the interfering links.

Let W be the cell edge user equipment (UE) with one dominant interfering station and single layer transmission.

Let $\tilde{u}$ contain the Gaussian distribution

The received signal model is estimated using the following equation (1)

$$\sigma = x_{n,1} y_{n,1} + X_n . y_n + \tilde{u} \qquad (1)$$

where $y_n = [y_{n,1}, \ldots\ldots, y_{n,c|n|}]^T$ is the signal vector transmitted by the dominant interfering node n

$X_n = [x_{n,1}, \ldots\ldots, x_{n,c|n|}]^T$ is the equivalent channel matrix from all layers of interfering node n,

$\tilde{u}$ = residual interference and noise originating from other evolved node.

c = number of spatial layers employed at the i^{th} node.

$$y_{n,1} = \underset{y_{n,1} \in Y_s, y_n \in Y_{in}}{\arg} \max p(\sigma \mid y_{n,1}; y_n) = \underset{y_{n,1} \in Y_s, y_n \in Y_{in}}{\arg} \min || \sigma - x_{n,1} y_{n,1} - X_n . y_n ||^2 \quad (2)$$

where Y_s and Y_{in} = set of all possible signals that can be transmitted on the layers of serving and dominant interfering nodes respectively.

Based on the available information on the modulation scheme of the interfering layers, we consider the following MLD receiver structures:

Non-transparent MLD: In this structure, the modulation scheme details are available at the receiver. It is obtained either through network signaling or through blind modulation techniques.

Transparent MLD: In this structure, the maximum-likelihood search for each interfering layer is performed over the extended constellation Y_{in}^{ex}. For instance, LTE-A systems should include all possible signals from the constellations.

Note: In LTE-A systems, some of the resource elements within a physical resource block (PRB) pair contains zero power. Here Y_{in}^{ex} for the ML search includes spare point.

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Eq. (2) can be solved using sphere decoding technique. The complexity of MLD can be decreased by scanning the signals alone in the interfering layers.

There is a possibility that the total number of layers (serving and interfering) which are jointly processed using Eq (2) may exceed the number of receive antennas of the UE.

For example, in two receive antenna case, the signals from two interfering layers can be jointly estimated.

3.3 Interference Cancellation

An Inter-carrier Interference (ICI) cancellation, a simplified parallel interference cancellation (PIC) scheme coupled with decision statistical combining (DSC) is used to cancel the ICI and to improve data symbol detection.

For cancelling the ICI, the ICI component on every sub carrier is calculated and it is subtracted from the receiver signal using the following eq (3).

$$V_a^{(t)} = (U_d^{(t)+})_a (Z - U_{nd}^{(t)} M^{(t-1)} - U_d^{(t)} M_{(zero,a)}^{(t-1)}) \quad (3)$$

The above equation reveals the decision statistics in the t[th] iteration for symbols transmitted from the a[th] antenna.

$$\text{where } U_d^{(t)+} = \begin{bmatrix} d(U_{1,1}^{(t)}) & d(U_{2,1}^{(t)}) & ..... & d(U_{E_T,1}^{(t)}) \\ d(U_{1,2}^{(t)}) & d(U_{2,2}^{(t)}) & ...... & d(U_{E_T,2}^{(t)}) \\ & .. & ... & . \\ . & . & . & . \\ . & & & \\ & . & ... & . \\ .d(U_{1,E_R}^{(t)}) & d(U_{2,E_R}^{(t)}) & ... & d(U_{E_T,E_R}^{(t)}) \end{bmatrix}. \quad (4)$$

$$U_{nd}^{(t)+} = \begin{bmatrix} nd(U_{1,1}^{(t)}) & nd(U_{2,1}^{(t)}) & ..... & nd(U_{E_T,1}^{(t)}) \\ nd(U_{1,2}^{(t)}) & nd(U_{2,2}^{(t)}) & ...... & nd(U_{E_T,2}^{(t)}) \\ & .. & ... & . \\ . & . & . & . \\ . & & & \\ & . & ... & . \\ .nd(U_{1,E_R}^{(t)}) & nd(U_{2,E_R}^{(t)}) & ... & nd(U_{E_T,E_R}^{(t)}) \end{bmatrix}. \quad (5)$$

Here $.d(U_{i,j}^{(t)})$ and $nd(U_{i,j}^{(t)})$ refers to force the non-diagonal elements and diagonal elements of $U_{i,j}^{(t)}$ to zero, respectively.

$M_{(zero,a)}^{(t-1)}$ = estimate for the transmitted symbol in the (t-1)[th] iteration, except for the elements related to the a[th] transmit antenna set to zero.

$(U_d^{(t)+})_a$ = a[th] row of pseudo-inverse of matrix $U_d^{(t)}$ in Eq.(4)

Considering the high-interference scenario, when the detector output becomes unreliable, a combining method called DSC is used which offers improved SINR.

The decision statistics are generated by the DSC module as a weighted sum of the current PIC output $V_a^{(t)}$ and the DSC output of the previous iteration $V_{DSC,a}^{(t-1)}$. Hence, the DSC output is given using the following equation (6)

$$V_{DSC,a}^{(t)} = \frac{(\lambda_{DSC,a}^{t-1})^2}{b} V_a^{(t)} + \frac{(\lambda_a^t)^2}{b} V_{DSC,a}^{(t-1)} \quad (6)$$

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where $b = \left(\lambda_{DSC,a}^{t-1}\right)^2 + \left(\lambda_a^t\right)^2$ $V_{DSC,a}^{(t-1)}$ and $\left(\lambda_a^t\right)^2$ are the variances of DSC estimate $V_{DSC,a}^{(t-1)}$, and PIC output $\left(\lambda_a^t\right)$, respectively.

$V_{DSC,a}^{(t)}$ is passed to the detector. The detected data symbols are fed to the channel estimator. This process is then repeated.

3.4 Channel State Estimation

In LTE, when the User Equipment (UE) receives the signal, the channel condition is estimated using Approximate Linear Minimum Mean Square Error (ALMMSE) method. The ALMMSE method estimates the channel based on the best-M Channel Quality Indicator (CQI) and Pre-coding Matrix Indicator (PMI) feedbacks.

The PMI is an index that represents the special direction of the MIMO channel and it offers the details related to precoding matrix. It can either be a constant over wideband system bandwidth, or frequency selective per sub-band depending on sub-frame duration and feedback strategy.

The RI represents the number of layers specially multiplexed during the downlink process and denoted by the minimum number of transmitting and receiving antennas.

The precoding matrix is given using the following equation (7)

$$\rho_j = \arg\max_{\rho_j \in \rho} \sum_{s=1}^{S}\sum_{t=1}^{T} O_{s,t}(\rho_i) \qquad (7)$$

Here S represents the sub-carrier over instantaneous time T

$O_{s,t}$ = mutual information for the specific resource elements (s, t)

In order to estimate the bits that can be transmitted per channel, the following post equalization for $SINR_{s,t,m}$ is estimated using the following Eq. (8)

$$O_{s,t} = \sum_{m=1}^{M} \log_2(1 + SINR_{s,t,m}) \qquad (8)$$

When there is increase in noise variation by mean square error ($MSE_{s,t}$), the post equalization SINR for M^{th} stream,

$$SINR_{s,t,m} = \frac{|S_{s,t}(m,m)|^2}{\sum_{i\neq m} |S_{s,t}(m,i)|^2 + \left(\varepsilon_t^2 + MSE_{s,t}\right)\sum_i F_{s,t}(m,i)} \qquad (9)$$

Where $F_{s,t}$ = filter matrix.

CQI is a 4 bits index that indicates the variation in the channel condition caused by signal propagation in the link between evolved Node (eNodeB) and UE.

The channel condition estimation based on CQI involves is discussed below:

Initially, CQI is generated at the eNode B, and a specific reference signal is transmitted to UE. On receiving the signal, UE estimates the channel condition. The channel parameters such as signal-to-interference plus a noise ratio (SINR), exponential effective SINR mapping (EESM), and mutual information effective SINR mapping (MIESM) are mapped into discrete values that represent the index of CQI. The UE transmits these CQI values to the eNodeB using a proper feedback mechanism.

The CQI mapping strategy from the EESM or MIESM is represented as in Eq (10).

$$SNR_{eff} = \mu\gamma^{-1}\left(\frac{1}{P}\sum_{p=1}^{P}\gamma\left(\frac{SINR_p}{\mu}\right)\right)$$

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Where P = used resource count

γ = exponential or bit-interleaved code modulation for EESM and MISESM respectively.

μ factor is adjusted using link level simulation to match the SINR for obtaining specified MSC as per CQI value.

IV. SIMULATION RESULTS

We use MATLAB version 7.12(R2011a) to simulate the proposed Interference cancellation and channel estimation technique for MIMO-LTE Advanced networks.
The simulation settings and parameters are summarized in Table 1.

NO	Parameter	Assumption
1	Duplex method and bandwidth	FDD: 10MHz for downlink
2	Network synchronization	Synchronized
3	Traffic model	Full buffer
4	Maximal number of co-scheduled users	4
5	BS Antenna	4Tx or 8Tx: uniform linear array with 0.5λ spacing
6	User antenna	1Tx or 2Rx: uniform linear array with 0.5λ spacing
7	Transmission scheme	ZF method, MU-MIMO, rank 1 per user
8	Scheduler	Proportional fair and frequency selective scheduling
9	Feedback	wideband **W**1, sub band **W**2 and Sub-band CQI and PMI
10	Link adaptation	error: N(0,1dB) per PRB
11	receiver type	ALMMSE
12	Simulation time	500subframes (1 ms/subframe)
13	Signal to Noise Ratio	-10:3:35

Table-1 Simulation Parameters

The proposed technique is compared with l Minimum Mean Square Error Interference Rejection Combining receiver (MMSE-IRC) system and Maximum-Likelihood Detection Interference Suppression (MLD-IS).

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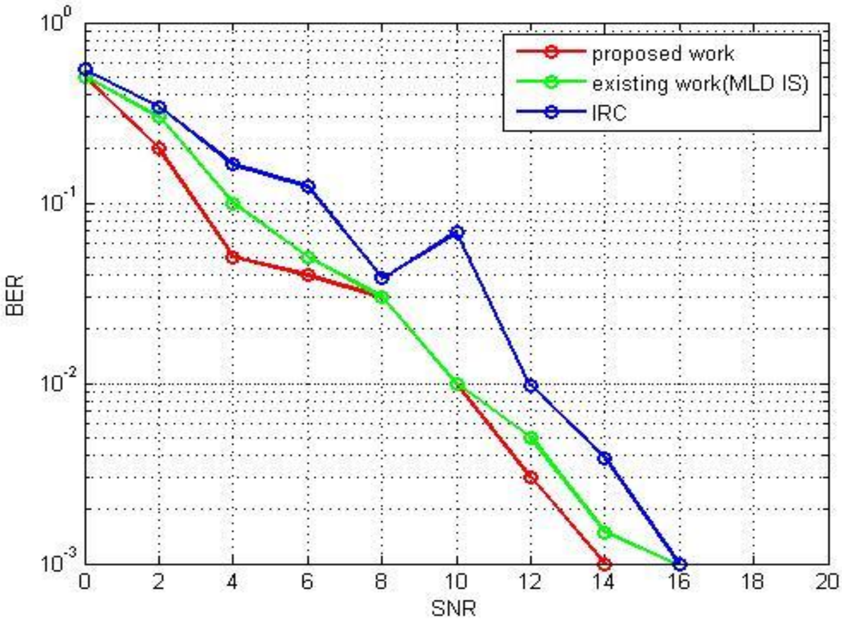

Figure-2 Results of BER for all the 3 Schemes

Figure-2 shows the Bit Error Rate (BER) values against SNR for all the 3 schemes. The figure shows that for MMSE-IRC, BER reduces at SNR 16, for MLD IS, it reduces at SNR 15. The proposed technique attains the reduced BER at SNR 14.

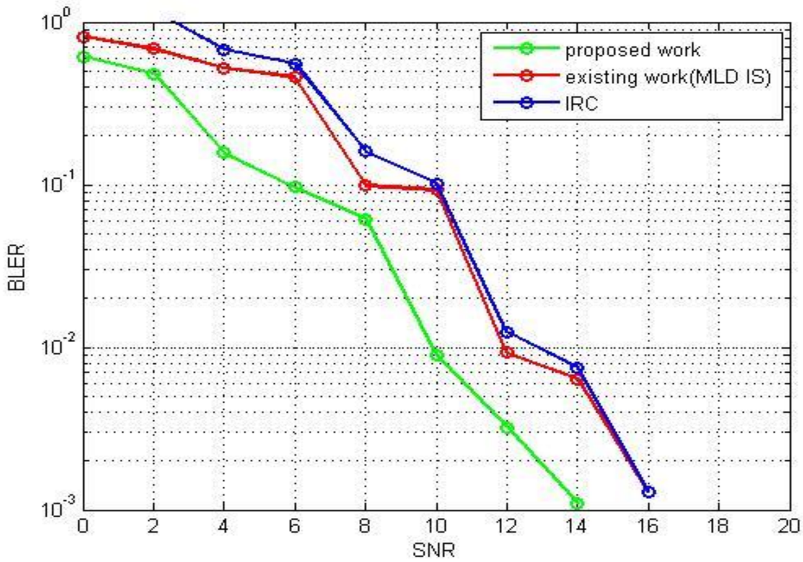

Figure-3 Results of BLER for all the 3 Schemes

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Figure-3 shows the Block Error Rate (BLER) values against SNR for all the 3 schemes. The figure shows that for both MMSE-IRC and MLD-IS, the BLER reduces at SNR 16, whereas for the proposed technique, the BLER reduces at SNR 14.

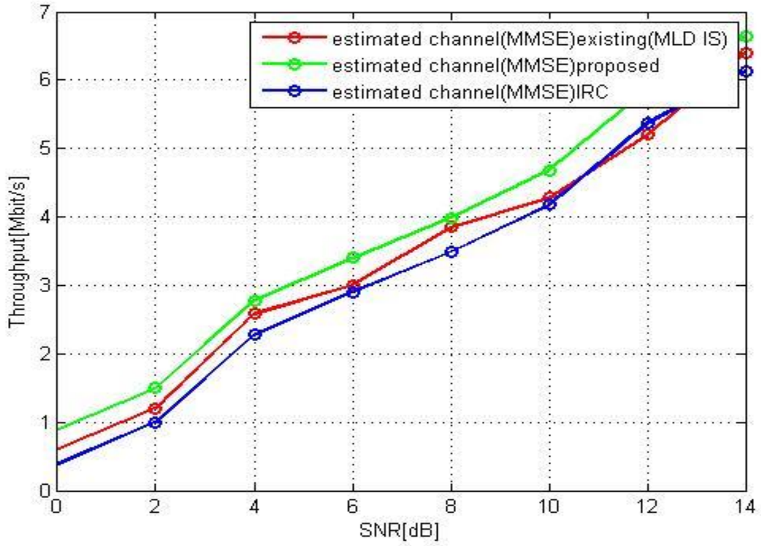

Figure-4 Results of MMSE Channel estimation for all the 3 Schemes

The channel estimation results by applying the MMSE method for all the 3 schemes are depicted in Figure-4. The figure shows that the proposed technique outperforms the other two techniques by attaining higher throughput. The proposed technique obtains the throughput in the range of 7 Mb/s followed by MLD IS at the range of 6.8Mb/s and MMSE-IRC at the range of 6 Mb/s.

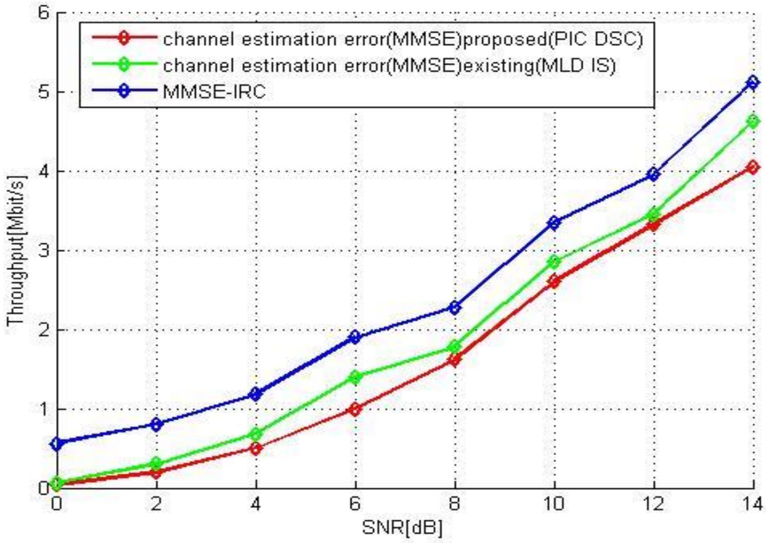

Figure-5 Results of MMSE Channel estimation Error for all the 3 Schemes

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The results of channel estimation error by applying the MMSE method for all the 3 schemes are depicted in Figure-5. The figure shows that the proposed technique outperforms the other two techniques by attaining lower estimation error. For the proposed technique, the error is in the range of 4Mb/s followed by MLD IS at the range of 4.8Mb/s and MMSE-IRC at the range of 5 Mb/s.

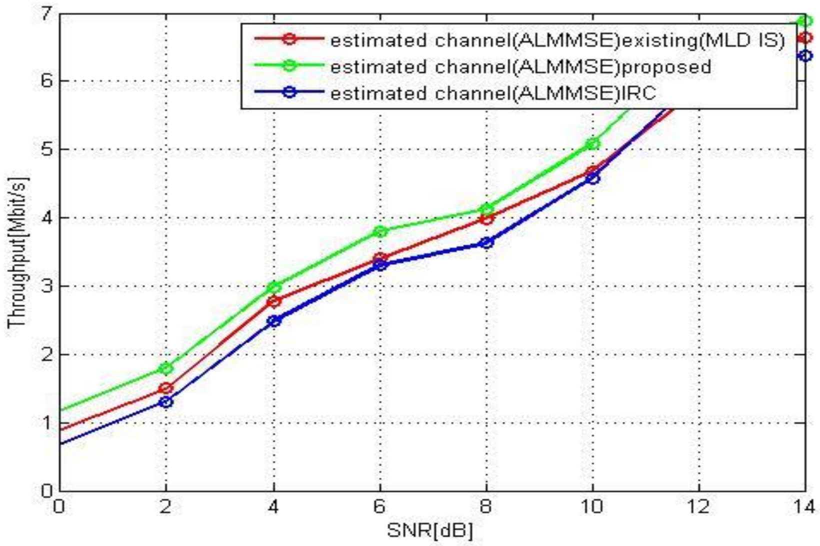

Figure-6 Results of ALMMSE Channel estimation for all the 3 Schemes

The channel estimation results by applying the ALMMSE method for all the 3 schemes are depicted in Figure-6. The figure shows that the proposed technique outperforms the other two techniques by attaining higher throughput. The proposed technique obtains the throughput in the range of 7 Mb/s followed by MLD IS at the range of 6.8Mb/s and MMSE-IRC at the range of 6.6 Mb/s.

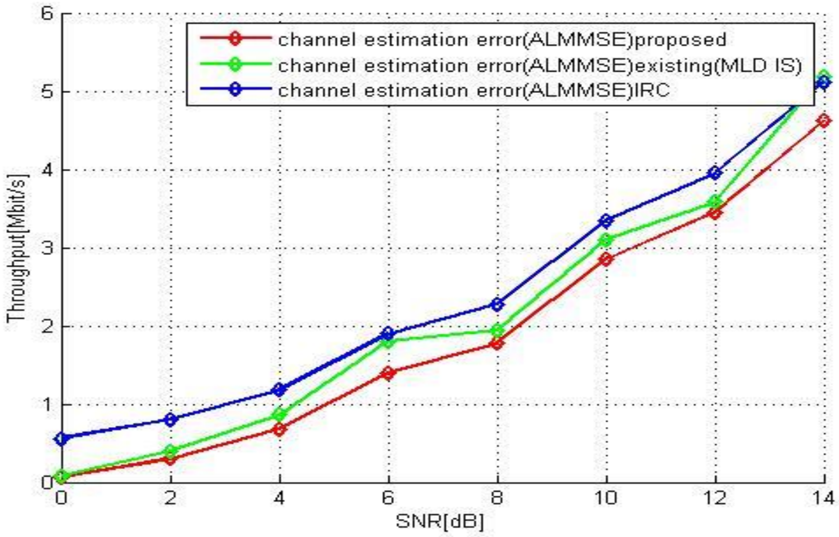

Figure-7 Results of ALMMSE Channel estimation Error for all the 3 Schemes

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The results of channel estimation error by applying the ALMMSE method for all the 3 schemes are depicted in Figure-7. The figure shows that the proposed technique outperforms the other two techniques by attaining lower estimation error. For the proposed technique, the error is in the range of 4.5 Mb/s followed by MLD IS at the range of 4.8Mb/s and MMSE-IRC at the range of 5 Mb/s.

V. CONCLUSION

In this paper, we have proposed to design a Channel Quality Estimation with Parallel Inter Carrier Interference (ICI) cancellation technique for MIMO-LTE-A networks. Initially the maximum-likelihood detection – interference suppression (MLD-IS) scheme is applied to suppress the interfering links. To cancel the ICI and improve data symbol detection, a simplified parallel interference cancellation (PIC) scheme is used along with decision statistical combining (DSC) in ICI cancellation method. The channel state is estimated using Approximate Linear Minimum Mean Square Error (ALMMSE) method based on the best-M Channel Quality Indicator (CQI) and Pre-coding Matrix Indicator (PMI) feedbacks. By simulation results, we have shown that the proposed technique reduces the computational process and the complexity.

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