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Research paper

Channel estimation for long term evolution downlink receiver system performance

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Abstract

3GPP LTE is the advancement of the UMTS because of ever-increasing requests for brilliant interactive media administrations as indicated by client's desires. Since downlink is dependably an essential factor in scope and limit viewpoints, extraordinary consideration has been given in choosing innovations for LTE downlink collector. In this paper, LTE-downlink receiver framework exhibitions of Channel Response estimations are tried and assessed utilizing FDD transmission plans. An insertion calculation is utilized to acquire all Channel Response estimations. In this model direct addition calculations utilized as a part of recurrence and image area. The high information rates and the high limit can be accomplished by utilizing the upsides of the two advances. These advances have been chosen for LTE downlink receiver. Pilot-assisted channel estimation is a strategy in which known signs, called pilots, are transmitted alongside information to get channel learning for legitimate deciphering of got signals. This paper goes for channel estimation for LTE downlink receiver framework. The execution of the framework recreated in various remote channel models that comprises of AWGN, RAW AWGN and Veh A channels. The execution of the framework is assessed utilizing distinctive regulations, for example, QPSK, 16 QAM and 64 QAM. Execution of these calculations has been measured as far as Bit Error Rate (BER) Vs Eb/No.

Keywords: *AWGN; BER ; Eb/No; LTE-A; VehA.*

1. Introduction

The 3GPP Long Term Evolution (LTE) Standard Release 10 [1], alluded to as Long Term Evolution Advanced (LTE-An), underpins diverse of new highlights contrasted with Release 8 [2] for achieving the objectives for 4G [3]. LTE-A detail incorporates expanding the pinnacle information rate and the upgrade of range proficiency, inertness and versatility. LTE-A framework is intended to be in reverse perfect with LTE framework, that implies a LTE portable can speak with a base station that is working LTE-A and the other way around [4]. The LTE-A Physical Layer (LTE-A PHY) is in charge of conveying the two information and control data between a base station (eNodeB) and portable client hardware (UE).

The LTE-A PHY utilizes some propelled innovations like Orthogonal Frequency Division Multiplexing (OFDM) and Multiple Input Multiple Output (MIMO) information transmission that are new to cell applications [5]. Orthogonal Frequency Division Multiplexing (OFDM) is an essential piece of LTE-A and is utilized to change over the frequency selective fading behaviour of the channel to frequency flat fading channel conduct [6]. This enhances the data transmission proficiency by dispose of Inter Symbol Interference (ISI). Different transmit and get receiving wires enhances the correspondence quality and limit of versatile remote frameworks. Knowing channel conduct is required for reasonable location, and unraveling at the collector. Thus, exact channel estimation is essential for LTE-A framework.

Channel estimation procedures for LTE-A framework can be classified as takes after:

(1) Least-squares (LS). (2) Minimum Mean Square Error (MMSE) [7 - 8]. In choosing the advances to involve in LTE, one of the key concerns is the trade-off between cost of usage and commonsense favorable position.

Major to this appraisal, consequently, has been an upgraded understanding distinctive situations of the radio spread condition in which LTE will be sent and utilized. The impact of radio spread conditions on the transmitted data must be assessed to recoup the transmitted data precisely. In this way channel estimation is an indispensable part in the recipient plans of LTE. In this proposal work, an itemized investigation of standard channel models in light of ITU and 3GPP suggestions for LTE has been finished. The fundamental concentration of the work is to research and assess the channel estimation strategies, for example, Minimum Mean Square Channel Estimation, Least Square Channel Estimation and Down Sampled Channel Impulse Response Least Square Estimation for LTE down connection. Subsequently a connection level test system in light of LTE physical layer particulars [9] has been exhibited. This test system imitates channel estimation calculations for standard channel models characterized for LTE, utilizing MIMO-OFDM and multi-level balance conspires in LTE down connection between the eNodeB and the user equipment (UE). The execution of the connection level test system is measured in terms of Bit Error Rate (BER) and Symbol Error Rate (SER) found the middle value of overall channel acknowledge of various engendering situations.

2. LTE Downlink receiver system model

In this LTE Downlink Receiver framework display is utilized to evaluate the 3GPP LTE downlink channel response (CR) with the pilot images helped for FDD plot. Places of reference images are in the accompanying fig 1.

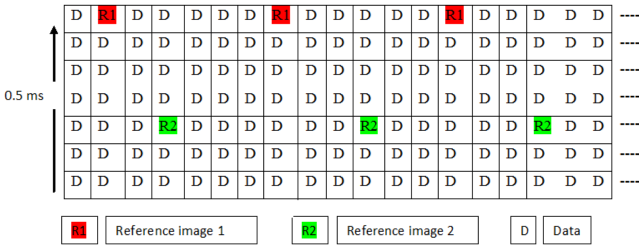

Fig. 1: LTE - Downlink Reference-signal image.

In LTE execution, the Reference Signal balance isn't settled as in the first figure. Parameters RS1 Offset and RS2 Offset are for the begin position of First reference image and Second reference image, separately. The minimum squares Channel Response assess at a pilot area can be given as

$$Hi = Yi/Xi \quad (1)$$

where Yi is the received Pilot image and Xi is the transmitted Pilot image on the I^{th} subcarrier. In the wake of getting the channel responses at pilot areas, an insertion calculation is utilized to get all Channel Response estimations. The addition calculations outlined in this model is straight insertion in recurrence and image area. In this model de-maps uniform QPSK, 16-QAM and 64-QAM to bits utilized for channel interpreting. When Mapping type is equivalents to 0, QPSK demapper is utilized. When Mapping type is equivalents to 1, 16QAM demapper is utilized. When Mapping type is equivalents to 2, 64QAM demapper is utilized. The 3GPP LTE FS1 downlink FDD RF recipient has up to six clients. The sub arrange for this model incorporates LTE Downlink Receiver, which is the baseband 3GPP LTE uncoded downlink beneficiary, and the QAM Demodulator. The LTE Downlink Time recurrence synchronization segment is utilized for timing and recurrence synchronization. It utilizes the P-SCH time space flag to yield the synchronization record and evaluated recurrence counterbalance. Both synchronization file and evaluated recurrence counterbalance are contribution to LTE Downlink demultiplexed outline. It initially repays recurrence balance by utilizing the assessed recurrence balance at that point yields the genuine radio casing by utilizing the synchronization list in the wake of expelling the Idle interim. This model causes one edge radio deferral. One radio edge (10 ms) incorporates 20 slots.

LTE Downlink Demultiplexer Slot is utilized to demultiplex one opening into seven or six OFDM images by expelling cyclic prefix. There are seven OFDM images for Normal Cyclic Prefix and six OFDM images for Extended Cyclic Prefix. The LTE OFDM Demodulator first exchanges input time space signals into recurrence area signals utilizing a FFT methodology. The demodulated signals are then created by evacuating NULL subcarriers and trading in addition to recurrence subcarriers and short recurrence subcarriers. The demodulated signals are contribution to the LTE Downlink Channel Estimator to get a channel motivation reaction (CIR) for every dynamic subcarriers. It works space by opening then it utilizes the primary reference images and the second reference images if accessible to get the genuine CIRs for places of reference images. At that point, the CIRs of different positions (aside from places of reference images) are gotten by inserting the CIRs of places of the reference images. Subsequent to obtaining the CIR of every dynamic subcarrier in each of the OFDM images, the recurrence area equalizer (one tap) or channel compensator can be utilized. The demodulated OFDM image can be gained from this recurrence space equalizer. LTE Downlink Demultiplexer OFDM Symbol demultiplexes the demodulated OFDM images (in one radio casing) into P-SCH, S-SCH, P-BCH, PDCCH and six UEs mapping signs and yields these signals.

3. System model & problem statement

There are two noteworthy issues in outlining channel estimators for wireless LTE downlink Receiver. The main disadvantage is that the course of action of pilot or reference motion for transmitters and receivers. The second disadvantage is that plan of an estimator with each low complexity and sensible execution. To keep up high information rates and low error rates in LTE downlink Receiver, the estimator ought to have low complexness and high precision. Proposed channel estimator Receiver algorithm as below.

Step 1 Encode the input data.
Step 2 Perform Channel Estimation Technique.
Step 3 Channel response estimation evaluated using pilot assisted FDD scheme.
Step 4 Use linear interpolation algorithm to obtain channel response estimation in frequency & symbol domain.
Step 5 Use QPSK, 16 & 64 QAM for mapping and demapping
Step 6 Both timing and frequency synchronization used to estimate the frequency offset and synchronization index.
Step 7 Tested up to six users in AWGN & VehA channel env.
Step 8 Both timing and frequency synchronization used to estimate the frequency offset and synchronization index.
Step 9 Demodulate and encoded to the receiver.
Step 10 Results are presented in terms of BER Vs Eb/No.

4. Simulation parameters & results

The execution of channel estimation strategies for LTE-downlink receiver system framework in limited on bandwidth 10/20MHz data transmission are designed in this model. The execution of Channel Response estimations are tried and assessed utilizing FDD transmission plans. In the wake of getting the Channel Responses at pilot areas, an introduction calculation is utilized to acquire all Channel Response estimations. The interpolation algorithms simulated in LTE-downlink receiver system is linear interpolation in frequency and symbol domain. AWGN, RAW AWGN and VehA channels are utilized in the design and QPSK, 16 QAM and 64 QAM has been considered as a mapping type model. Results are introduced as far as BER Vs Eb/No as shown in fig 2, 3 and 4. The parameters for LTE downlink receiver framework utilized as a part of design are represented in Table1.

Table 1: Simulation Parameters

Parameters	Values
Internal Reference Frequency	2500MHz
Resource Block	25
Bandwidth	10 & 20 MHz
Users equipment	six
Cyclic prefix	7 for Normal OFDM symbol
Channel Estimation Techniques	Pilot
Channel type	AWGN, RAW AWGN & VehA
Equalizer	Frequency Domain
Mapping Type	QPSK,16 QAM, 64 QAM

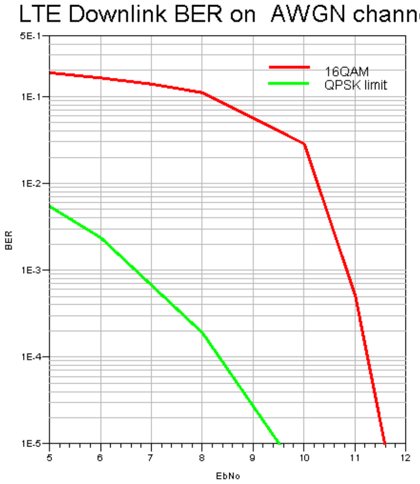

Fig 2: LTE Downlink Receiver BER on AWGN channel

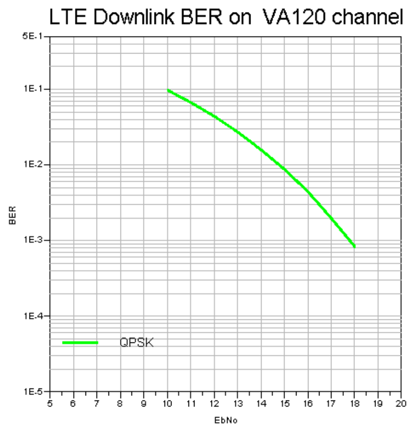

Fig 3: LTE Downlink Receiver BER on VehA channel

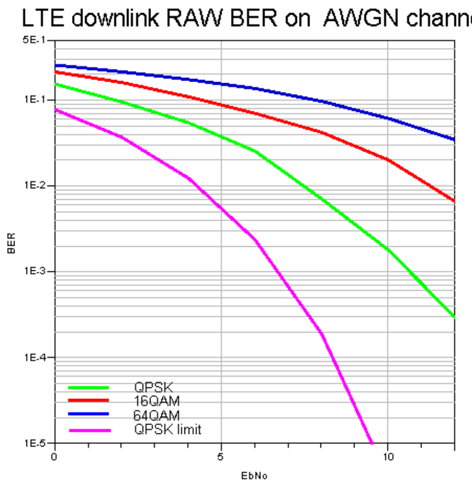

Fig 4: LTE Downlink Receiver Raw BER on AWGN channel

As an inference from the graph for BER Vs Eb/No, AWGN channel error rate is better than VehA channel during LTE downlink constraints as referred in Table 2, 3 and 4. For higher order modulation performances is better as compared to lower order modulation in AWGN channel. And also the energy consumption during downlink is almost similar to fixed uplink constraints which overcome the criteria that during downlink generally higher energy is consumed when compared to uplink.

Table 2: Table depicts energy consumption per bit for LTE downlink constraint with different sub carrier modulation schemes in AWGN. BER considered is $1E^{-3}$.

Sub Carrier Modulation	Eb/No on Downlink AWGN Channel
QPSK	6.6
16 QAM	10.8

Table 3: Table depicts energy consumption per bit for LTE downlink constraint with different sub carrier modulation schemes in AWGN. Raw BER considered is $1E^{-1}$.

Sub Carrier Modulation	Eb/No on Downlink AWGN Channel
QPSK	1.8
16 QAM	4.8
64 QAM	8.0

Table 4: Table depicts energy consumption per bit for LTE downlink constraint with QPSK schemes. Raw BER considered is $1E^{-1}$.

Sub Carrier Modulation	Eb/No on Downlink VA120 Channel
QPSK	10

5. Conclusion

The performance of channel estimation techniques for LTE-downlink receiver system based on the 10/20MHz bandwidth are simulated in this model. The performance of Channel Response estimations are tested and evaluated using FDD transmission schemes. After getting the Channel Responses at pilot locations, an interpolation algorithm is used to obtain all Channel Response estimations. The interpolation algorithms designed in this model is linear interpolation in frequency and symbol domain. AWGN, RAW AWGN and VehA channels are employed in the simulation and QPSK, 16 QAM and 64 QAM has been considered as a modulation scheme. As an inference from the graph and table shows that an AWGN channel performances is better as compared to VA120 channel then higher order modulation energy consumption is less as compare in lower order modulation.

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