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Optimum Hierarchical Modulations for OFDM Systems and Uplink Virtual MIMO Systems

Authors

V.S. Suresh Kumar, Dr. K. Ravi Kumar

Research Scholar , Karpagam University, Coiambatore.
Tamil University, Thanjavur

Abstract

A fast linear minimum mean sq. error (LMMSE) channel estimation methodology has been planned for Orthogonal Frequency Division Multiplexing (OFDM) systems as compared with the standard LMMSE channel estimation, numerical results show that the NMSE of the planned methodology is very close to that of the standard LMMSE methodology that\'s in addition verified by hypothesis. in addition, hypothesis shows that the performance of the planned methodology is type of identical thereupon of the standard LMMSE methodology in terms of bit error rate (BER).

In mobile worldwide ability for microwave access (WiMAX) or third Generation partnership project long evolution (3GPP-LTE), transmission virtual multiple input multiple output (MIMO) technology is adopted to perform abstraction multiple access with two movable subscriber stations (PSSs), where each PSS has associate antenna. As two PSSs transmit at an equivalent time on identical orthogonal frequency division multiple access (OFDMA) resource blocks, the transmission capability square measure doubled.

Index Terms— *Mobile TV, turbo code, Frequency-Division Multiplexing Access pilot signal , broadcast cellular system.*

1 Introduction

Frequency division multiplexing (OFDM) is associate economical high rate transmission technique for wireless communication [1]. OFDM presents edges of high spectrum efficiency, simple and economical implementation by victimization fast|the fast|the short} Fourier retread (FFT) and so the inverse quick Fourier retread (IFFT), mitigation of bury image interference (ISI) by inserting cyclic prefix (CP), and robustness to frequency selective attenuation channel.

We propose the use of adaptational modulation modes and adaptational code rates for Turbo-coded OFDM in a pair of altogether totally different ways: one turbo code theme and a separate turbo code theme. In every schemes, each subband [4] contains a bunch of subcarriers that the modulation mode and turbo code rate is about by the signal/noise (SNR) of subcarriers throughout this subband. The separate turbo code theme uses a precise turbo code frame for each subband channel estimation has been successfully accustomed improve the performance of OFDM systems.

Multiple inputs multiple output (MIMO) techniques ar in all probability expected to be introduced in most mobile communication systems for an increase in wireless rate. The transmission MIMO Techniques have together been adopted in mobile worldwide ability for microwave access (WiMAX) systems that ar supported the IEEE 802.16e − 2005 standards [5] or third generation partnership project semi permanent evolution (3GPPLTE) systems [6].

The paper is organized as follows. Section one try of describes the OFDM system model. Section a pair of system model three describes the Bit Error Rate (BER) Comparison between LMMSE. we've an inclination to investigate the Virtual MIMO coding Schemes in Section four and climbable video transmission in section five. Radio Access Network System Level machine in section vi and

Link level machine in seven. The simulation results and numerical winds up in Section eight followed by conclusion in Section nine.

2. System Model

The OFDM system model with pilot signal (i.e., work sequence) assisted is shown in Figure one. There square measure N sub carriers employed in OFDM system, the transmitted signal x(i, n) in time domain once inverse fast Fourier rework (IFFT) is given by

$$x(i,n) = \mathrm{IFFT}_N[X(i,k)] = \frac{1}{N}\sum_{k=0}^{N-1} X(i,k)\exp\left\{\frac{j2\pi nk}{N}\right\}$$

Where X(i, k) denotes the transmitted signal in frequency domain at the kth subcarrier within the ith OFDM image. The comb-type pilot pattern [4] is adopted during this paper. The pilot subcarriers square measure equispaced inserted into every OFDM image. it's assumed that the amount of the full pilot subcarriers is Np, and therefore the inserting gap is R. every OFDM image consists of the pilot subcarriers and therefore the information subcarriers. it's assumed that the index of the primary pilot subcarrier is k0.

3. Bit Error Rate (BER) Comparison between LMMSE

The BER of LS, LMMSE ar channel frequency response at pilot subcarriers is obtained by LS, LMMSE, and thus the projected fast LMMSE skilled. Once the channel frequency response is obtained, we tend to tend to use most likelihood detection to induce the denumerable signal X(i, k) to boot, the correct channel estimation refers to that the channel frequency response is believed by the receiver earlier.

Observe that the BERs of LMMSE skilled is extraordinarily close to that of the projected fast LMMSE skilled over the SNR vary from zero sound units to twenty 5 sound unit and people them unit concerning one decibel worse than the correct channel expert, over the SNR ranging from zero sound unit to twenty 5 sound unit. The LMMSE skilled and thus the projected LMMSE skilled unit concerning 3-4 sound unit above the LS skilled at the same BER over the SNR ranging from zero sound unit to twenty 5 sound unit.

4. Virtual MIMO Decoding Schemes

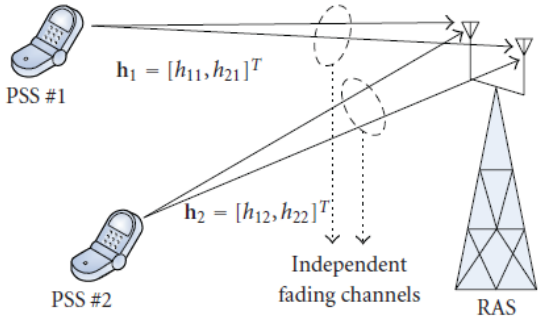

Figure 4.1: transmission virtual MIMO systems

Figure 4.1 shows a virtual MIMO system where for simplicity we have got an inclination to require under consideration two PSSs and one radio access station (RAS).We assume one transmission antenna for each PSS, {and two|and a couple of|and a pair of} PSSs transmit data streams on constant OFDMA resources at the same time as a result of the RAS receives multiple data streams through 2 antennas, it makes a 2 × 2 freelance attenuation channel condition.

5. Scalable video transmission

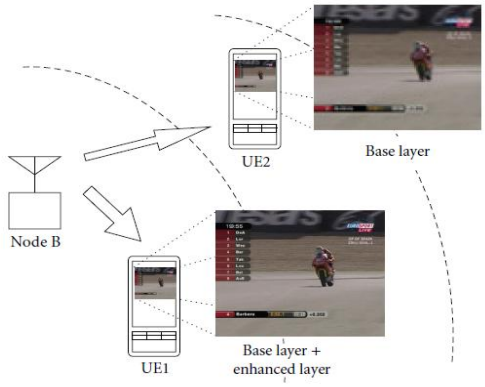

Figure 5.1: ascendible video transmission

The introduction of hierarchal modulation in associate passing broadcast cellular system desires associate ascendable video coded as shown in

Figure five.1 [11, 14], where rock bottom layer transmission provides the minimum quality and one or extra sweetening layers supply improved quality at increasing bit/frame rates and resolutions.

This technique significantly decreases the storage costs of the content provider compared to the printed distribution where for one video sequence excessive video sequences ought to be keep at the server to alter its distribution to completely totally different|completely different} customers with different terminal capabilities. Besides being a attainable account content adaptation, ascendable video schemes may also allow degree economical usage of radio resources in enlarged MBMS.

6. Radio Access Network System Level machine

For the aim of validatory the work given throughout this section, it had been developed a system level machine in Java. This dynamic behavior includes the user (e.g., quality and variable traffic demands), radio interface and (Radio Access Network) RAN with some level of abstraction.

The system level machine (SLS) works at coordinated universal time Interval (TTI) rate and typical quantity of each simulation is 600 seconds. Table one depicts the simulation parameters. It presents the parameters used within the link and system level simulations supported 3GPP documents.

The sample parameters depend on the setting shadowing is due to the existence of giant obstacles like buildings and additionally the movement of UEs in and out of the shadows. typically|this can be} often sculptured through a technique with a lognormal distribution and a correlation distance.

Vehicular A (with rate v = thirty km/h) channel model was chosen as a results of it is a important take a glance at channel in 3GPP specifications additionally; it permits for direct comparison with previous system level simulations done by the authors. In OFDM systems the required parameter is that the foremost delay of the multipath profile and its relation with the amount of the time guard between OFDM symbols to avoid intersymbol interference. 3GPP has nominal a quick time guard with regarding four.75 μs Associate in Nursingd an extended one with sixteen.67 μs

Table 1: Link and system simulation parameters for cellular situation

Transmission bandwidth	10 MHz
Cyclic prefix size	72
FFT Size	1024
Carriers space (kHz)	15
Available bandwidth	9 MHz
Sample time (ns)	130
Max Tx Power (dBm)/sector	46
Number of used subcarriers/sector	200
Number of used subcarriers/cell	600
Freq. Reuse	1/3
Subframe duration (ms)	0.5
Interfering cells transmit with % of Max Power	90
Cell Radius (m)	750
InterSite Distance (m)	1500
Cellular layout	Hexagonal
Sectors	3 sectors/cell
Number of cell sites	19
Antenna gain of the base station	17.5 dBi
Width of beam of the antenna at −3 dB	70 degrees
Front/Back ratio of the antenna	20 dB
Antenna pattern radiation of the base station	Gaussian
Propagation Model	Okumura-Hata
Downlink thermal noise	−100 dBm
Cable Loss	3 dB
Fade out standard deviation due to shadowing	10 dB

7. Link level machine

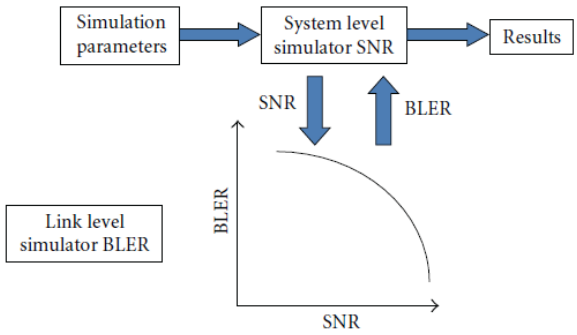

Figure 7.1: Interaction between link level machine and system level machine.

The link level machine is needed for the system machine to form a receiver model which will predict the receiver (Block Error Rate/Bit Error Rate) BLER/BER performance. The system level machine is needed to model a system with associate outsized vary of mobiles and base stations, and algorithms operational in such a system.

The link level machine is inserted at intervals the system level machine through the utilization of a selected performance parameter (BLER) like a determined signal to interference and noise relation (SNR) determinable at intervals the terminal or base station. In Figure seven.1 is shown the simulators interaction.

8. Numerical Results

Transmission Assumptions

Within the simulation for every system, we have got a bent to line the BER target to 10−2. There unit of measurement 768 subcarriers in each OFDM image, that unit of measurement split into sixteen subbands with forty eight subcarriers in each among the separate turbo code adaptive system, for every turbo code frame, subbands from twelve OFDM symbols unit of measurement combined modulation symbols.

For the one turbo code adaptive system, we have got a bent to still assumed 12OFDM symbols unit of measurement combined and each one 768∗12 = 9216 subcarriers unit of measurement self-enclosed in one turbo code frame. So, the length of the signal once turbo secret writing and modulation is 768∗12 = 9216 modulation symbols.

Simulation Results

In our separate turbo code and single turbo code adaptive turbo-coded OFDM system, as mentioned on high of, there unit of measurement five modulation modes with code rate 1/2, and therefore the non transmission case. among the separate turbo code system, if one subband is determined to victimization BPSK, the length of the turbo code frame utilized during this subband is 282; whereas for the subbands victimization QPSK, 8AMPM, 16QAM, and 64QAM, the length of the turbo code frames unit of measurement 570, 858, 1146, and 1722, severally.

Compared to the separate turbo code system, the length of the turbo code among the only turbo code adaptive system is much longer. Once none of the subbands unit of measurement marked as non transmission, the length of a turbo code with BPSK altogether subbands is 4602, and so the length of a turbo code with 64QAM altogether subbands is 27642.

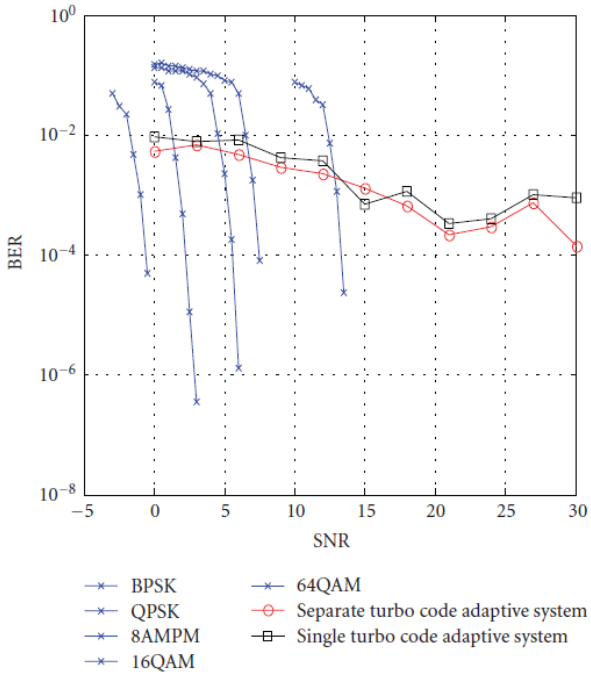

Figure 8.1: BER of separate turbo code system and single turbo code system.

A frequency selective weakening channel is assumed throughout this simulation. The channel model among which each regulator amplitude follows associate freelance Third Baron Third Baron Rayleigh distribution. The response is shown in Figure eight.1.

In this simulation, smart data of the channel transfer operate at the receiver is assumed. To boot the channel impulse response is not changed throughout one turbo code frame (12 OFDM symbol) block. Figure 8.1 illustrates the BER performance of every regulate turbo coded OFDM systems practice these 5 modulation schemes, with the most effective adaptation algorithmic program.

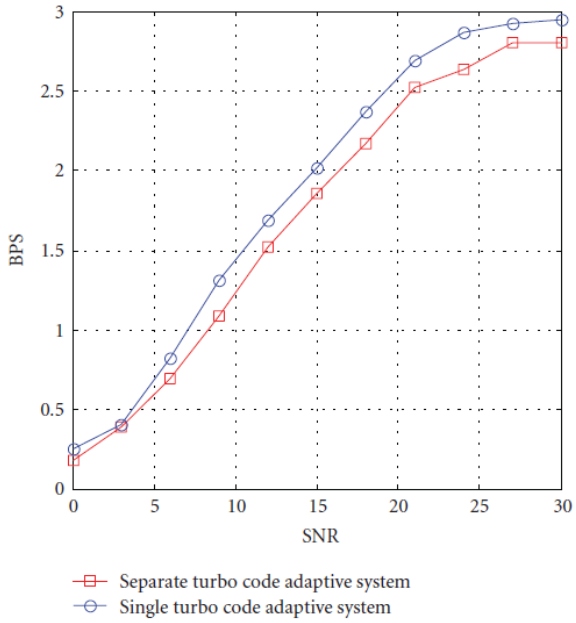

Figure 8.2: output of separate turbo code system and one turbo code system.

Figure 8.2 shows the output in bits per second (bps) of every systems victimization same adaptation algorithmic rule. The dotted lines in Figure eight.1 unit of measurement the BER performances of the non accommodative OFDM system with one/2 rate turbo code and conjointly the 5 modulation schemes mentioned more than. The red solid line with circle in every Figures eight.1 and 8.2 unit of measurement the BER and output performance for the separate turbo code system, whereas the blue solid line with sq. in every figures is that the BER and output performance for the one turbo code system. These figures show that the one turbo code accommodative OFDM system can provide higher rate output performance than the separate turbo code accommodative.

9. Conclusion

In this paper, a fast LMMSE channel estimation methodology has been planned and altogether investigated for OFDM systems. This paper has bestowed two accommodative modulations and code rate turbo coded OFDM schemes, specifically the separate turbo code system and conjointly the one turbo code system, further as descriptions of the system structures and transmission signal block structure vogue.

We have an inclination to adopt a social dancing approach to estimate the time-varying channel coefficients over multiple OFDMA symbols. We have an inclination to together gift a performance analysis of the channel estimation approach and derive a closed-form expression for the channel estimation variances. It's shown that the estimation variances, not like typical superimposed coaching job, approach to a tough and quick lower-bound that will entirely be reduced by increasing the pilot power.

The link-level simulation is performed below the concept of fantastic synchronization between two PSSs, and performance of the virtual MIMO system may even be slashed simply just in case of any imperfect synchronization. We've got studied associate degreed evaluated the use of QAM hierarchic constellations in AN OFDM system as a multiresolution theme for the improved MBMS network. things supported multicell networks whereas not and with macro diversity combining were evaluated victimization multiresolution supported 16QAM hierarchic modulation.

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Authors Profile

V.S.Suresh Kumar received the BSc. degree in Computer Science, M.C.A from Bharathidasan University, Trichy, in 1996, 1999 Respectiviely. He got Mphil(CS) from Mononmanium Sundranar University, Thirunelvali, in 2002. His research interests are in the areas of ad-hoc networks.

Dr K. Ravi kumar received Doctorate degree in Computer Science, from Sathiyabama University, Chennai. Currently, he working as Assistant Professor in Tamil University, Thanjavur.. His research interests are in the areas of ad-hoc networks.