Channel Estimation Technique for OFDM using an Adaptive Algorithm

Shruthi M S[1] , Sanket N Shettar[2], A V Srikantan[3]

[1]MTech Student, Digital Communication and Networking, GSSSIETW Mysuru.
[2]Assistant Professor, Dept of ECE, GSSSIETW, Mysuru.
[3]Principal & Regional Head of BSNL, RTTC, Mysuru

Corresponding Email: *[1]shrutim.s4@gmail.com

ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) is different from the Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) techniques because it is one of the Multi Carrier Modulation (MCM) scheme. It is used in the 3G and 4G LTE-A(Long Term Evolution Advanced) to increase the data rate and achieve the high spectral efficiency compared to the other modulation techniques. A time varying environment channel causes the various effects such as fading, interference and noise which causes the declination in the performance of the system. To reduce the above mentioned effects and for proper reception of the transmitted information the process called Channel Estimation becomes necessary in the OFDM systems. The Channel Estimation is a process used to determine the channel parameters depending on the channel conditions using the different parameters. This paper describes the Proposed Channel Parameter Based (CPB) Channel Estimation .

Keywords: OFDM, LTE-A, MCM, CPB

INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is widely considered as a promising choice for future wireless communications systems due to its high-data-rate transmission capability with high bandwidth efficiency. In OFDM, the entire channel is divided into many narrow sub channels, converting a frequency-selective channel into a collection of flat frequency independent channels. Moreover, Inter Symbol Interference (ISI) is avoided by the use of Cyclic Prefix (CP). In fact, OFDM has been adopted in digital audio broadcasting (DAB), digital video broadcasting (DVB), digital subscriber line (DSL), and wireless local area network (WLAN). At the receiver the Channel Estimation is used to recover the original information based upon certain estimation algorithm.

Channel estimation in OFDM is usually performed with the aid of pilot symbols. Since each sub carrier is used in flat fading, the techniques from single-carrier flat fading systems are directly applicable to OFDM. For such systems Pilot-Symbol Assisted Modulation (PSAM) on flat fading channels involves the sparse insertion of known pilot symbols in a stream of data symbols.

LITERATURE SURVEY

In this paper cubic interpolation and Gaussian interpolation filter is used both filters are compared with the linear interpolation filter. There is an error by the high bit error rate caused from these two filters and to reduce the errors caused by these two filters the low pass filter is used combined with the interpolation filters for a improved performance and to reduce the complexity of the system. This method is used in the applications like Digital Audio Broadcasting systems. [1]

In this paper channel estimation is done by using the algorithm called Quasi Static Channel type of channel estimation. By using

this algorithm the response of the channel is assumed to be constant for a many OFDM symbols but in mobile scenario the response of the channel varies due to the fast fading and when there is a high mobility the response many vary even in the one OFDM symbol so this Quasi Static algorithm is suited only for a static are only smaller time varying channels.[2]

In this paper Basis Expansion Model algorithm is used. In this algorithm different types of the basis functions are considered for modeling of the channel in time varying environment, usually the basis functions are known to the receiver only need to estimates the model coefficients and it needs to be regenerated after obtaining the coefficients of the model. Sometimes the channel response any vary even for one symbol of the OFDM symbol and it produces the error called as the inherent model error so the estimated [3]

In this paper estimation is done for parameters instead of estimating the response by using the method called as Maximum Likelihood algorithm. The parameters fr estimation are complex amplitude and the Doppler effect, the main advantage of estimating the parameters is that it produces the less errors than compared for estimation of channel response and does not changes very quickly. This Maximum Likelihood algorithm estimates the parameters jointly and this algorithm is suited only for smaller Doppler shifts because it increases the complexity of the system as increase in the Doppler shift. This is the main drawback of this algorithm for dynamic environment.[4]

In this paper the Order Recursive algorithm is used in faster time varying channels. It is also used for estimating the parameters instead of the response. This algorithm is suited for the larger Doppler shifts because it estimates the parameters path by path instead of the joint estimation; it uses the Q^{th} order Taylor's expansion [5]

In this paper the channel parameter based channel estimation is used. It describes the channel estimation for OFDM in uplink transmission to estimate the channel parameter. This algorithm is also used to estimate the channel parameters instead of estimating the response of the channel. This is used to reduce the Doppler Effect caused by the distortion during time varying of the channel. It uses the training symbols as well as the transit symbols for reducing the Doppler Effect and complex amplitude in the time varying environment [6]

METHODOLOGY

In the propagation channel of wireless systems, it is apparent that even for one source there are many possible propagation paths and angles of arrival. If several transmitters are operating simultaneously, each source potentially creates many multipath components at the receiver. Therefore, it is important for a receive array to estimate the angles of arrival in order to decode which emitters are present and what are their possible angular locations. This information can be used to eliminate or combine signals for greater fidelity and suppress interferers.

PREVIOUS ADVANCEMENT

Classical channel detection scheme methods are essentially based on beam forming. The two classical techniques for Direction of Arrival (DoA) are the Maximum Entropy Method and the Maximum Likelihood method. The basic idea behind the classical methods is to scan a beam through space and measure the power received from each direction. Directions from which the largest amount of power is received are taken to be the CHANNEL DETECTION SCHEMEs.

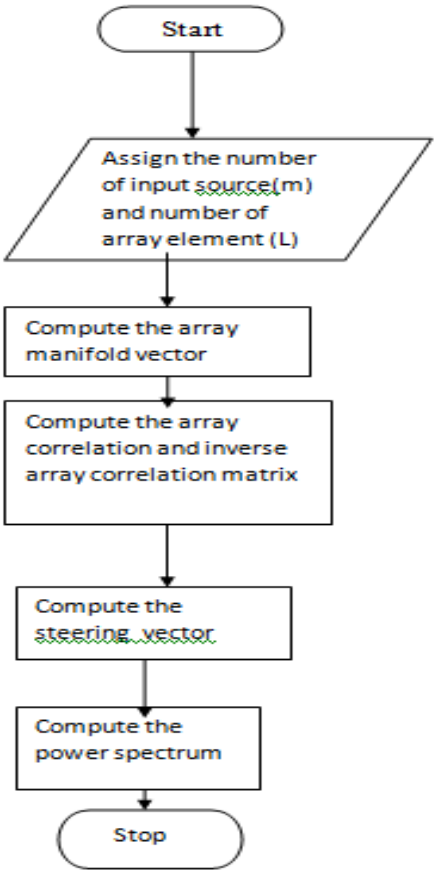
Macro Cellular CPB method:

In this method a rectangular window of uniform weighting is applied to the time series data to be analyzed. For bearing estimation problems using an array, this is equivalent to applying equal weighting on each element. Macro Cellular CPB method is also called Ordinary Beam forming Method (OBM).

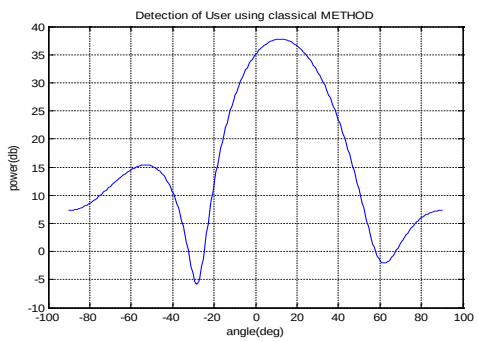
Traditional CPB Method:

Traditional CPB Method It is also alternatively a maximum likelihood estimate of the power arriving from one direction while all other sources are considered as interference. Thus the goal is to maximize the Signal to Interference Ratio (SIR) while passing the signal of interest undistorted in phase and amplitude.

Flow chart



Simulation results of Classical CPB Channel Estimation



CURRENT ADVANCEMENT

Proposed CPB Channel Detection Scheme:

The goal of the proposed CPB technique is to exploit the rotational invariance in the signal subspace which is created by two arrays with a translational invariance structure. Proposed CPB inherently assumes narrowband signals so that one knows the translational phase relationship between the multiple arrays to be used. The proposed CPB assumes that there are M< L narrow-band sources centered at the center frequency *f*. M is number of sources and L is the number of antenna elements. These signal sources are assumed to be of a sufficient range so that the incident propagating field is approximately planar. The sources can be either random or deterministic and the noise is assumed to be random with zero-mean. The proposed CPB assumes multiple identical arrays called **Doublets**. Doublets can be separate arrays or can be composed of sub arrays of one larger array. It is important that these arrays are displaced translationally but not rotationally.

CONCLUSIONS

This paper addresses the CPB channel estimation problem for OFDM uplinks in time-varying channels. To estimate the channel parameters, the time-frequency-representation of the channel response is used. The proposed algorithm can achieve the similar performance with greatly reduced complexity compared with the algorithm in existing literature. To cancel the impact of residual Doppler shift and complex amplitude in the time varying environment.

ACKNOWLEDGEMENTS

I would like to thank BSNL RTTC Myuru, for their constant support and assistance in doing this project.

REFERENCES

[1] Li, Y.: 'Simplied channel estimation for OFDM systems with multiple transmit antennas', IEEE Trans. Wirel. Commun., 2002, 1, (1),pp. 67–75

[2] Simon, E.P., Ros, L., Hijazi, H., et al.: 'Joint carrier frequency offset and channel

estimation for OFDM systems via the EM algorithm in the presence of very high mobility', IEEE Trans. Signal Process., 2005, 60, (2), pp. 754–765

[3] Tang, Z., Cannizzaro, R.C., Leus, G., Banelli, P.: 'Pilot-assisted time-varying channel estimation for OFDM systems', IEEE Trans. Signal Process., 2005, 55, (5), pp. 2226–2238

[4] Teo, K.D., Ohno, S.: 'Optimal MMSE finite parameter model for doubly-selective channels'. Proc. IEEE Global Telecommunication Conf. (GLOBECOM), 2007, pp. 3503–3507

[5] Haykin, S.: 'Adaptive filter theory' (Prentice-Hall, 1996) Proc. IEEE Global Telecommunication Conf. (GLOBECOM), 2010, pp. 3503–3507

[6] Halwatsch, F., Matz, G.: 'Wireless communications over rapidly time-varying channels' (Academic Press of Elsevier, 2012)