Performance Analysis of OFDM System through Pseudo-Pilot and Greedy Algorithms

Rosy Dhiman, Akshay Rana, Mamta Arora

Abstract: ***In this paper, to investigate a pilot problem for Greedy algorithms using channel estimation in OFDM system. The Greedy algorithm is used for channel estimation in OFDM system over AWGN fading channel. Thus, Greedy algorithm is used for the optimization process. The OFDM is providing a high speed data rate and low complexity because it reduces the intersymbol interference for transmission over frequency selective channel. Hence, Greedy algorithms use a pilot to create overhead problem, this problem solve with pseudo-pilot. On the basis of BER (bit error rate) performance of OFDM is evaluate. In Simulation results show, BER vs SNR compared the performance of pilot aided and pseudo-pilot using Greedy algorithms.***

Index Terms: Greedy Algorithms, Channel Estimation, OFDM System, Sparse Channel.

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is a multicarrier modulation technique which uses very wide area in wireless communication. In OFDM system, each channel has many sub channel using different frequencies which is used lower data rate for parallel transmission. Now a days, It is used in various wireless application like digital audio broadcasting (DAB) systems, digital video broadcasting systems, and the wireless LAN standards like high performance wireless local area network (HYPERLAN), IEEE® Std. 802.11™ (Wi-Fi) and IEEE® Std. 802.16™ (WiMAX) [3]. OFDM is a special case of multicarrier transmission where a single data stream is transmits over a number of lower rate subcarrier. OFDM is treated as both modulation technique and multiplexing technique. Thus, closely spaced subcarrier is overlapped the ICI is reduces or zero. Benefit of OFDM system is to saving the bandwidth as compare to FDM. In all wireless applications, few parameters are important like quality, of the transmitter signal is good and acceptable. Channel state information using OFDM system to improve the performance and spectral efficiency. Thus, OFDM is widely use, Due to its high speed data rate with higher bandwidth efficiency and high spectral efficiency. The all channel is divided into many narrow sub-channels in OFDM, and convert the frequency selective channel into a frequency-flat channel. Thus, the basic technique used in OFDM (orthogonal frequency division multiplexing) that is FDM (Frequency Division Multiplexing). Hence, OFDM is differing from the FDM show in Table I.

Table I

FDM	OFDM
FDM is a single carrier narrow band signaling process	OFDM is a multicarrier wide band signaling process
Low spectral efficiency	High spectral efficiency
In FDM, no relationship between the carriers	OFDM, is a orthogonal carriers
Guard band between the carriers	No Guard band because signal is overlap
In FDM more interference is there system	Overcome the ISI

However, CSI (channel state information) to describe how a signal propagates from transmitter to receiver And it represent the combined effect. CSI can be evaluated by reasonable pilot subcarriers [3] and the OFDM is depends upon the exact channel estimation. Thus, channel estimation is an important parameter to improve the channel accuracy and improved the channel performance. It is an important parameter of OFDM system. In OFDM the accurate performance provide in the form of noise [6], the spectral efficiency is measured on bps/Hz that is

$$C = b \times \log(1+S/N)$$

Hence, C is the capacity of channel, b is the bandwidth, and S/N is signal-to-noise ratio. The channel state estimation efficiency is required for coherent detection. And some pilot is used as a references signal in OFDM system and the whole frame are used as a pilot frame [2]. Pilot knows the value of transmitter side because of coherence. In general, more estimation technique like blind channel, non-blind channel used to estimate the channels. The most probably block and comb type estimation is used. The fading channel of OFDM systems is used in block type like two-dimensional (2D) signal for time and frequency domain. The 2D is based on the term of mean-square error and 1D is based on comb type. In practical implementation, the 2D estimator is too complex as compare to 1D. Hence, this combination high speed data rates and low bit error rates for OFDM systems is used in estimators [1-7]. The block-type pilot is based on least square (LS), minimum mean-square error (MMSE). The comb type pilot is based on LS estimator with 1D and maximum likelihood (ML) estimator [8-12] and so on. Hence, OFDM signal is optimized by various components that are coding, adaptive loading. Maximize coherent detection is used for pilot bit allocation and they arise critical issues for performance and efficiency.

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In current, the minimum coherent detection is used to better performance and accuracy. To remove the neighboring pilot subcarriers is little, the execution also, precision of channel estimation are higher. The nature of channel estimation depends upon pilot design, which straightforwardly influences the execution of channel estimation calculations [3].The utilization of differential stage move keying (DPSK) in OFDM systems need to track a period changing channel.

1.1. OFDM System

OFDM system is a subset of frequency division multiplexing in which a single channel uses various sub-carriers on neighboring frequencies. Thus, different symbols are transmitting over a different subcarrier. A spectrum is overlap but the signal is orthogonal, hence the name is OFDM. The benefit of OFDM system is to saving the bandwidth. In transmitter side, binary data is used for any modulation technique (QPSK, BPSK, and QAM). The data transmit from the serial to parallel than pilot is inserting as a reference signal. IFFT (inverse fast Fourier transformation) is used to convert the signal in time domain. Then the modulated data used in cyclic prefix. ISI (Inter-Symbol-interference), remove when CP is added and whole information goes from channel. Thus the same concept using the receiver side, to modulate data will be demodulating with the help of FFT in frequency domain. Then remove CP and pilot insertion, the output will be get. Thus, the OFDM fig1.1 shows that [6]

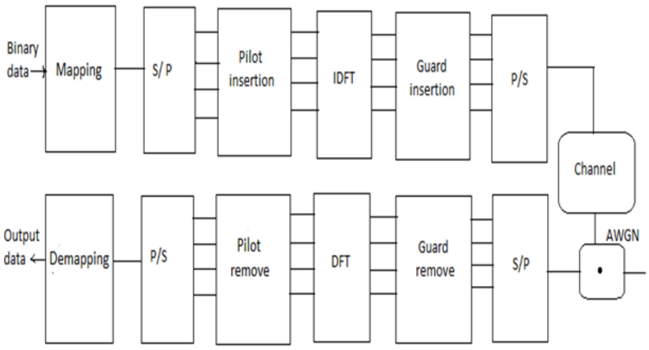

Fig. 1.1 show the OFDM system [6]

1.2. Channel Estimation

Channel estimation is used to estimate the properties of channel and it reduces the complexity. This is an essential part of coherent detection, and coherent receivers must know the carrier phase information hence we must transmit pilot data and based on this data. The detector is estimates the channel impulse response and compensates it [2]. To be able to estimate the original transmitted OFDM symbol, we need accurate channel state information. Channel state information can be obtained by using transmitted data and pilot tones and the important parameter to improve a channel performance and efficiency [8].

$$Yp = Xp .h + np$$

However, Yp is the received vector, Xp is a DFT sub-matrix from the transmitter, h is a channel attenuation vector, and n is a no of vector [5]. There are two principle issues in planning channel estimators for remote OFDM systems. The primary issue is plan of pilot data, where pilot implies the reference flag utilized by both transmitters and recipients. The second issue is the plan of an estimator with both low unpredictability and great channel following capacity. The two issues are interconnected. Types of Channel Estimation: - Two different types of channel estimation are: Block Type, Comb Type [8].

Table II

Slow fading is used	Fast fading is used
All pilot sub-carrier use as a block type.	Sub-carrier is used as a specific periods.
Don't effect provides on spectrum efficiency in block type.	The effect provide on spectrum efficiency
Not required interpolation	Required interpolation
Estimation based on LS, and MMSE modified MMSE	Estimation may be based on LS, ML and PCMB

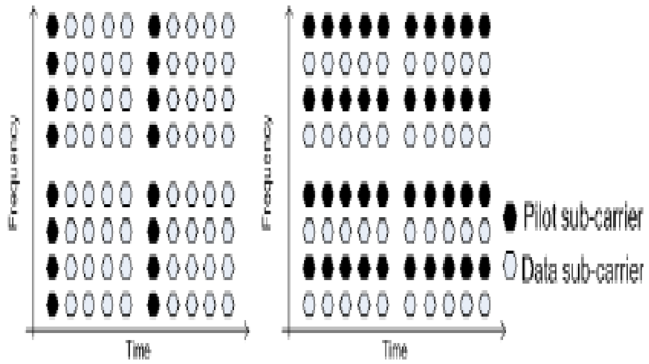

Fig. 1.2 Block type and Comb type [3]

1.3. Sparse Channel Estimation in OFDM system

In Sparse channel, to identify the non-zero channel tap in free space. Thus, the unwanted channel noise is removing with the help of Sparsity based method [2]. Two equations are solve this method (1) minimize- coherence (2) directly method (pilot bit allocation). In this methods to detect the signal and channel location. The advantage of these methods is follows as (1) Decrease MSE: No information about the location of non-zero coefficient of receiver and estimator are not realizable. (2) Reducing Overhead: more noise is receiver side [2]. The pilot subcarrier is not depending on the delay. Sparse channel estimator to show the better performance in OFDM. Many sparse channel models are like sparse frequency selective channel, sample spaced, non-sample channel etc. Finally, different sparse channel estimation methods to recover the different channel in communication environments [5].

II. PROPOSED WORK GREEDY ALGORITHMS WITH PSEUDO-PILOT

The pilot block is replaced with pseudo-pilot so it reduces the overhead. In proposed work the Greedy algorithms using a pilot overhead problem is arises. In currently, to solve the problem of overhead using a pseudo-pilot. And simulation result shows the system performance of both pilots. Thus, pseudo-pilot is better than pilot. The Greedy algorithm is utilized to solve the optimization problem using the OFDM system.

When the signal is complex it solves in the simple way.

E.g. multipath fading, when the signal is received directly line of sight (LOS) there is no attenuation, noise etc. Thus, a greedy algorithm has computational complexity for their structure. The power needs to certain number of bits, and it allocated to other subcarriers which show the Greedy is optimal. Hence, this data is satisfied when this process is completed by pilot [1]. Thus, the BPSK, QPSK modulation technique is utilized and integrated by pilot (as a reference signal). The unwanted noise is there and signal is modulate with AWGN channel. Hence, show the fig. 2.1 of pseudo-pilot channel estimation.

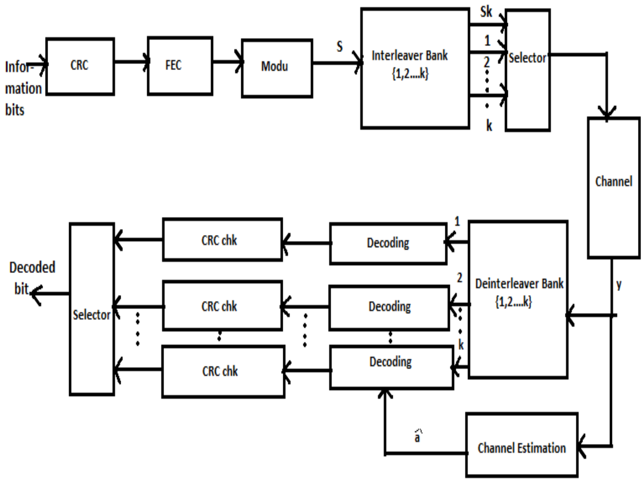

Fig. 2.1 Generate Pseudo-Pilot for Channel Estimation [11]

III. SIMULATION RESULTS

We consider, a BPSK OFDM system with N= 128subcarriers and pilot subcarriers (Mp) = 16, which is used for channel estimation. Thus, a Rayleigh fading channel (h) is generated with frame length L=50 and b randomly select the channel taps are varying with fading parameters from in each OFDM symbol. The attenuation is independently satisfied in each tab and identical distributed like N (0, 1).

Table I. Specification and Parameters

Specification	Parameters
FFT size	128
Number of carrier (Mp)	16
Modulation type	BPSK, 4-QAM
Channel model	AWGN fading channel

MATLAB R2016a and an Acer laptop with an Intel Dual Core CPU running at 2GHz and 2GB memory are used for simulation. In proposed work, Greedy algorithms are used in pilot to arise the overloading problem and they show the low complexity and high run time. In current, the faded channel is used with OFDM system. In general, 2D (2 dimensional) Block type channel estimation scheme as compared to 1D Comb type is higher complexity and large time delay. Hence, the block-type (2D) channel estimation schemes are more suitable for slow fading channel, and comb-type (1D) pilot suitable for fast fading channel. Fig. 1 BER (Bit error rate) vs SNR (signal-to-noise-ratio) show that the comparison of Greedy algorithms using pilot and pseudo-pilot. It shows that, the pseudo-pilot performance is better than pilot.

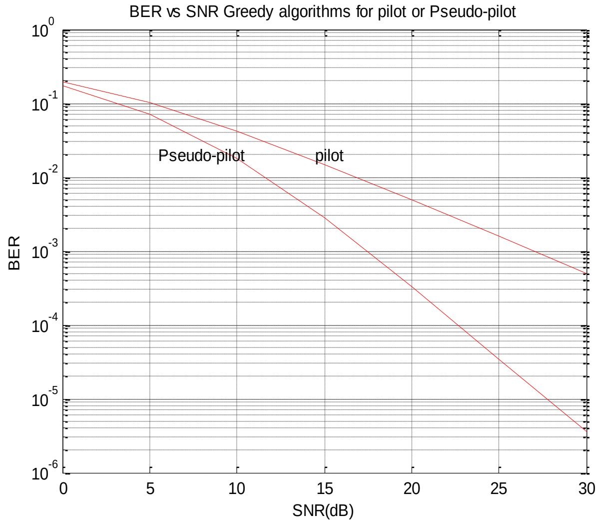

Fig. 1 Comparison of Pilot or Pseudo-Pilot for BER vs SNR

IV. CONCLUSION AND FUTURE WORK

In this paper, to investigate the problem of pilot overhead during the channel estimation and reduces the complexity. In Simulation results, the BER and SNR for both pilots and show the accuracy and system performance. Hence, pseudo-pilot overcomes the overhead problem and it is better than pilots. In future, work on the pseudo-pilot in LS (least square) estimator.

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