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# INTERFERENCE MANAGEMENT FOR OFDMA IN SIGNAL TRANSMISSION

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**ABSTRACT**

*In recent year, there has been tremendous growth in multimedia applications over the internet. The significant bandwidth requirement of multimedia has increased the demand for the radio spectrum. The scarcity of radio spectrum has challenged the conventional fixed assignment policy. As a result cognitive radio has emerged as a new paradigm to address the spectrum underutilization problem by enabling the users to opportunistically utilize the unused spectrum. In this work, the OFDMA as a protocol has been used for the resource, to be allocated during data transmission due to flexibility and adaptability. On the basis of the OFDMA scheme, it is been aimed to perform subcarrier allocation and power allocation for users. When the rate of the users are increased, then the result of utilizing available channels is improved. In this design, Interference management approach is used to examine the power allocation between the subcarriers without much interference, by using Water Drifting Algorithm (WDA).WDA is an iterative process to allocate power rather than water filling algorithm using the constant power. The expected result of this proposed system will be analyzed by the performance between the Peak Average Power Ratio (PAPR) and Peak Signal to Noise Ratio (PSNR) that maintains the efficiency of power distribution in the channel and also observe the result of comparing the obtained actual CSI and Estimated CSI in order to manage the interference.*

***Keywords: OFDMA, Interference Management, water drifting algorithm, Actual CSI, Estimated CSI.***

## I. INTRODUCTION

With the far reaching arrangement of high information rate wireless networks and the upgrades in video pressure innovations, the familiar of and interest for wireless multimedia transmission have been always expanding. With an end goal to ensure the client fulfillment under distinctive channel conditions, various crosslayer and multiuser resource allocation systems have been proposed in the related work (see, e.g., [1] and references in that). On the other hand, as the worldview for range access shifts towards that of cognitive radio [2], new calculations are required to make the most productive utilization of the accessible resources and give the most elevated quality of service (QoS) to the supporters. In such a situation, an essential attribute of the video handling subsystem is to be versatile to the fluctuating transfer speed.These days above half of voice services and 70% of information traffics happen inside [3]. Lacking of indoor scope has prompted expanding interest, which have been considered in real wireless correspondence benchmarks, for example, 3GPP LTE/LTE-Advanced [4]. Committed channel sending of data, are appointed with diverse (or orthogonal) frequency bands, and may not be favored by administrators because of the lack of spectrum resources and troubles in execution. While in co-channel organization, where the channels offer the same spectrum, then cross-level interference could be serious [5], Due to the major part of subchannels, their abilities and scope should not be influenced by co-channel. Power control has generally been utilized to alleviate inter-channel interference in co-channel arrangement.

A considerable measure of work has likewise been done on subchannel allocation in co-channel arrangement of channels. In [6], dispersed channel choice plans are proposed for channels to maintain a strategic distance from inter-channel interference, at the cost of decreased frequency reuse effectiveness. In [7], a subchannel allocation calculation in light of a potential amusement model is proposed to moderate both co-tier and cross-tier interferences. As of late, a few studies considering both power and subchannel allocation in channels have been accounted for. In [8], a joint power and subchannel allocation calculation is proposed to amplify the aggregate limit of thickly sent channels. In the collaborative resource allocation plan [9], cross-tier interference is approximated as added substance white Gaussian clamor (AWGN). In the Lagrangian double decomposition-based resource allocation [10], constraints on cross-tier interference are utilized as a part of power allocation, yet subchannels are relegated randomly to the clients.

In this paper, it is organized as follows. In “Interference Management System” section, the water drifting algorithm and iterative algorithm for managing the interference is proposed. Performance of the proposed method is evaluated by simulations in “Simulation results and discussion” section. ‘Conclusion’ which concludes the end result of paper.

## II. INTERFERENCE MANAGEMENT SYSTEM

To provide the video streaming transmission with greater user video quality and to shrink the delay while it is transmitted in cognitive radio networks is the main objective, to obtain this three goals are there. They are following as,

1. To perform subcarrier and power allocation for different cognitive users and observe such that the sum rate of the cognitive users is increased, which results in improving utilization of available channels.
2. To estimate the power performance of the subchannel while the data is large by analyzing the subcarriers during the transmission.
3. To evaluate the interference management between the channels, when the data bits are transmitted and received in the network.

The issue of OFDMA multi-user Interference administration depends on the channel estimation is considered in this paper. Enlargement of overall system capacity, in view of available instantaneous CSI is considered by estimated channel state information as error prone at the transmitter and full channel state information at receiver. Ideal power dissemination between diverse subchannels is computed logically, and it is demonstrated that equivalent power allocation among subcarriers is verging on close to the optimum capacity. Besides, the optimum number of pilots and the measure of power allocated between pilot and information subcarriers is computed diagnostically, with the assistance of water drifting algorithm. In the event that the full channel state information is exists in the scope of estimated channel state information, then the interference has been overseen in the well way.

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### III. PROPOSED WORK

The Proposed work is motivated by the open challenge about CRNof Interference management in the channel state Information for the full duplex communication. Theproposed strategy utilizes equalizers as a part of a training mode operation and utilization of the Nyquist Pulse molding channels productively minimizes the inter symbol interference (ISI) prompted by the channel. The matched signals are demodulated to recreatethe desired bit sequences. The data bit successions are initially balanced utilizing M-QAM adjustment methods and then square root raised cosine filters are utilized as pulse shaping filters.The channel is displayed as additive white Gaussian noise channel .The channel motivation reaction is standardized utilizing the greatest reaction esteem. At that point direct equalizers are actualized at the receiver to diminish the channel distortions.The block diagram of the proposed work system framework for Interference approach is appeared in Fig 1.1.

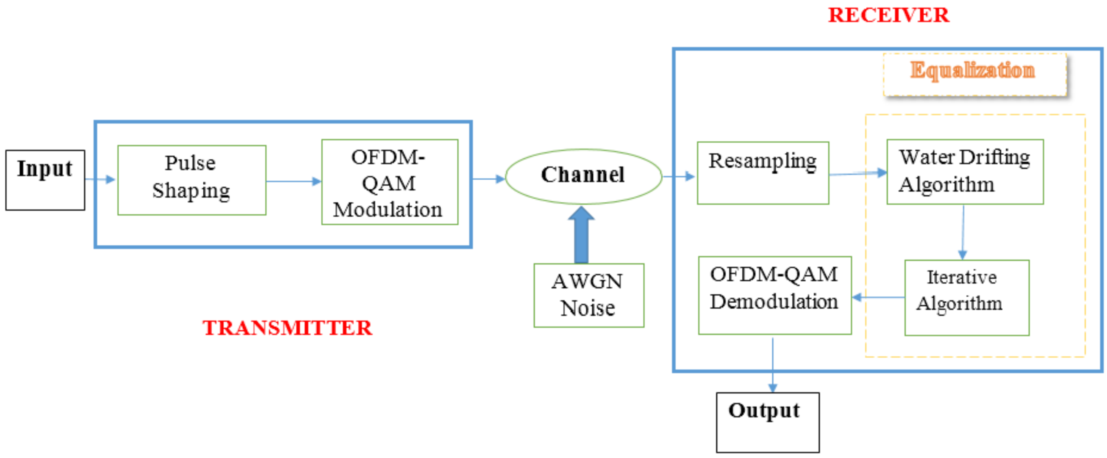


**Fig 1.1: System Framework for Interference approach**

The algorithms which is used for maximizing the overall system capacity for the interference management is given by, water drifting algorithm and iterative algorithm. They are described as follows.

### 3.1 Water Drifting Algorithm

The process of water drifting is similar to pouring the water in the vessel.The total amount on water filled (power allocated) is proportional to the Signal to noise ratio of the channel.

Power allocated by the individual channel, as shown in the following formula,

$$Power\ allocated = \frac{pt+\sum 1/Ci}{\sum chan} - 1/c_i \qquad (1)$$

where, $P_t$ is the power budget of OFDM system which is allocated among the different channels and c is the channel matrix of system.

The capacity of a MIMO OFDM is the algebraic sum of the capacities of all channels and given by the formula below.

$$Capacity = \sum_{n=1}^{m} log_2(1 + powerallocated * C) \qquad (2)$$

We have to maximize the total number of bits to be transported. As per the scheme following steps are followed to carry out the water drifting algorithm.

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**Algorithm Steps:-**

1. We don't have to reorder the OFDM sub channel pick up acknowledgment in a sliding request.
2. Do the inverse of the channel gains.
3. Water drifting has non uniform step structure due to the inverse of the channel gain.
4.At first take the aggregate of the aggregate power Pt and the reverse of the channel gain It gives the complete territory in the water filling (power allocation) and opposite power gain up.

$$P_T + \sum_{n=1}^{m} {}^{1}/{c_i} \quad (3)$$

5. Adopt the original water level by the formula given below by taking the average power allocated (average water Level).

$$P_T + \frac{\sum_{n=1}^{m} {}^{1}/{c_i}}{\sum chan} \quad (4)$$

6. The each subchannel power values are calculated by deducting the inverse channel gain of each channel.

### 3.2 Iterative Algorithm for Maximizing Channel Capacity

To process the best power allocation, given the measure of power assigned to pilots, the boost of the aggregate capacity of a multi-user system is required. Sub-channel allocation must be done in a route in which each subchannel is distributed to a user who has the best sub-channel reaction. Presently, the issue of power allocation between users is spoken to by the mathematical statement as beneath,

$$max \sum_{n}^{N_s} log_2\left(1 + \frac{p_n H_n{}^2}{\sigma^2 + p_n{}^2}\right) subject\ to \left(\sum_{n}^{N_s} p_n\right) = p_s. \quad (5)$$

where $p_s$ is total power for data transmission, after pilot insertion.

By the Lagrangian optimization method, one can reach to the equation 6,

$$L_a = max \sum_{n}^{N_s} log_2\left(1 + \frac{p_n H_n{}^2}{\sigma^2 + p_n{}^2}\right) + \lambda\left(\sum_{n}^{N_s} p_n - p_s\right) \quad (6)$$

The Newton Method is used for the optimization but with little modification is represented in 7,

**Minimization of** $f(p) = -\sum_{n}^{N_s} log_2\left(1 + \frac{p_n H_n{}^2}{\sigma^2 + p_n{}^2}\right) subject\ to\ Ap = b \quad (7)$

$$where\ A = [1, 1, 1 \ldots . 1]_{1 \times N_s},\ b = p_t\ .$$

**Steps To Be Constructed In Iteration Algorithm:**

The process is to be initialized by,

1) $p = \frac{p_{tt}}{n_c}$
2) Set $\varphi = m_x$
3) Set M = $\{1,2,\ldots\ldots.,N_c\}$
4) Compute the capacity $cap_{old}$

The loop of the process for iteration is calculated by,

1) Compute H, g, w, $\Delta$p for the indices $\epsilon$ $\{m_x$ xor X$\}$
2) Update the vector as $p_x = p_p + \propto * \Delta p$
3) Update $m_x = m_x \cup \{n | p_n < 0, \forall\ n \in X\}$

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4) Set $p_n = 0, n|p_n < 0, \forall n \in X$
5) Progress the updated P on the area distinct by Constraint.
6) P= $p_s$*P/ ||p||

The condition for terminating the loop process for iteration is proceed by,

Compute $c_{new} \rightarrow$ if, $cap_{new} = cap_{old} < \Delta c_{th}$ exit,

Else $cap_{old} = cap_{new}$ => Go to Step 2.

in which, $m_x$ is a set including subcarrier indices which are deprived of power due to their unsatisfactory subchannel response. Set X contains all subchannel indices which for simplicity, throughout this document, are selected from 1 to $N_c$.

The parameters considered here are,

$p_{tt}$ = Total average Transmission power

$p_n$ = Power allocated to "n" sub channels

$p_s$ = Power allocated to the particular channel

Np= No. Of. Pilots in each block

Nc= No. Of. Subcarriers

N= Total Available of Subcarriers.

$\propto$= Ratio of Total power allocated to data subcarriers

The Optimization of power allocation between data and pilot carriers for equal power distribution is given by $\propto$ values differentiated with Lagrangian equation and setting the result to zeros, best value for power allocation, $\propto_{opt}$, can be obtained.

$$\frac{\partial c_{avg}}{\partial N_s} = 0 \rightarrow \frac{N_s \sigma^2}{p_t} - \frac{1}{\alpha^2} + \frac{p_t}{\alpha^2} \sum_{i=0}^{L-1} \left( \frac{1}{\sigma^2_{h,i}} + {(1-\alpha)p_t}/{\sigma^2} \right) \quad (8)$$

For cases in which $\frac{1}{\sigma^2_{h,i}} \ll {(1-\alpha)p_t}/{\sigma^2}$ value of $\frac{1}{\sigma^2_{h,i}}$ can be ignored and $\propto_{opt}$ is obtained according to the below equation.

$$\frac{N_s \sigma^2}{p_t} - \frac{1}{\alpha^2} + \frac{L\sigma^2}{(1-\alpha)^2} = 0 \rightarrow \propto = \frac{1}{1+\sqrt{L/N_s}} \quad (9)$$

## IV. SIMULATION RESULTS

In this paper work the OFDMA signal in the data transmission is analyzed in terms of power performance of the level of interference. The assumed data is based on the 16- QAM technique. Hence, 2^4 is calculated. So the no.of. Bits per each subchannel is 64. Here, totally 4 subcarriers can be available. Hence the total number of bits to be transmitted at the transmitter is 256 bits. The size of each OFDM block to add cyclic prefix block size is 16. The length of the cyclic prefix is taken as (0.1 * block_size). The Testing Method of this work handled by MATLAB R2009b.

There is a chance of excess data is possible while transmission, especially that too in multimedia communication. This causes delay or jitter in the transmission. In order to reduce the delay, here the power performance is analyzed for OFDMA signal is shown in fig 1.1.Interference is anything which modifies, or disrupts a signal as it travels along a channel between a source and a receiver. The term typically refers to the addition of unwanted signals to a useful signal. It is important to analyse the interference of the signal when the maximized capacity along with the CSI is referred from fig 1.2- 1.6.

The received data from the OFDM signal and data and the data of any four subcarrier for sample is compared to estimate the power performance when the PAPR decreases the PSNR will increases. This reduces the noise in the system for the interference management is shown in the fig 1.1.

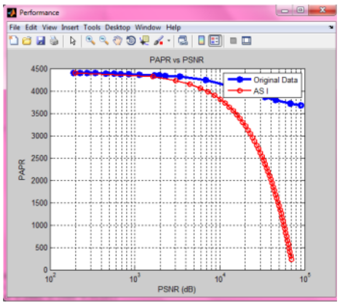


**Fig 1.1 Results of Received Signal Performance between PAPR vs. PSNR**

In fig 1.3, given fixed value of ASNR = 15dB, the system performance versus different values $\propto$ of is illustrated. It can be seen that there is an optimum value for parameter $\propto$, in which the graph peaks. The green dashed lines are the optimum value of $\propto$ computed from eqn. 9.

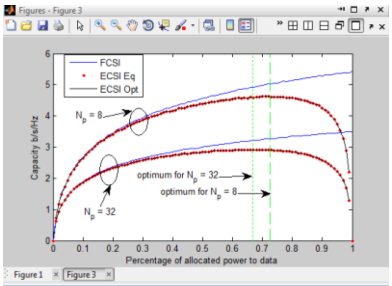


**Fig 1.2 Simulation results of System Performance vs. Ratio of Allocation Power between Data**

In this figure 1.3, the amount of ASNR is swept and the system performance is depicted. Here, $\propto = \frac{N_s}{N}$ and it is fixed. It is obvious from figure that equal power distribution among all subcarriers is near optimum for ASNR greater than 6 dB for the iterative algorithm block.

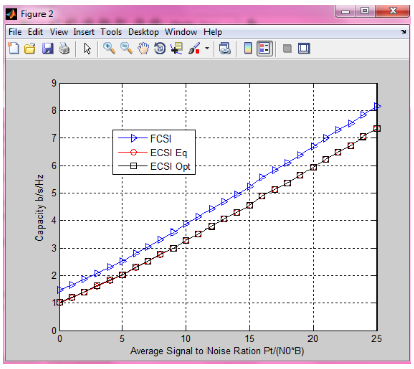


**Fig 1.3 Simulation Results of system performance versus ASNR**

The performance of the proposed iterative algorithm, ASNR is 6 dB, Np=L , and $\propto$ is 0.25 Ns/N. Figure shows that within a few number of iterations the algorithm converges to the optimum point from the initial point, which is the equal power allocation. It also shows the computed λ based on Lagrangian equation. As it is expected, the value of λ is the same for all data subchannel, which satisfies the analytical computation. The red boundaries depicted in figure b, is the 0.001 percent uncertainty region for λ is shown in the fig 1.4.

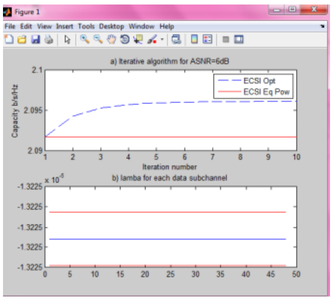


**Fig 1.4 Simulation results for the performance of iterative algorithm a) convergence of the capacity versus iteration number b) computed lambda for each subchannel**

Optimum power allocation among the data subchannel is depicted in fig 1.5 a. In fig 1.5 b., the noise to subchannel ratio is illustrated. As it can be seen from Figure, the worse the estimated subchannel response is less the amount of power allocated to that subchannel is considered as output from the equalizer block.

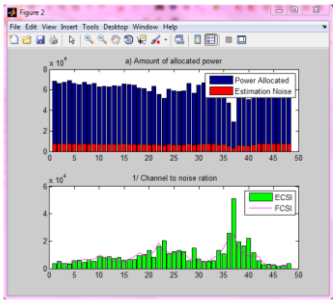


**Fig 1.5 Simulation Result of Power Allocated with the Estimation Noise**

The obtained result is clearly state that there is an interference can be managed in the OFDMA signal is found from the full CSI which lies within the estimation region of CSI and then maximum iterative capacity for every subchannel is allowed by the Estimated CSI.The findings stated in table. 1.1.

**Table 1.1: Analysis between Full CSI and Estimated CSI of Channel**

| S.NO | CSI ANALYSIS | CSI VALUE |
|---|---|---|
| 1 | Actual CSI obtained when the 16- QAM OFDM signal is transmitted. | 1.0221 |
| 2 | Estimated CSI is obtained for the 16- QAM OFDM signal. | 2.0917 |
| 3 | Maximum Estimated CSI is obtained for the Iterative process when the power is to be allocated dynamically | 2.0961 |

## V. CONCLUSION

In this research work, the resources are allocated for the data transmission with the OFDMA/M-QAM have been progressed. The Subcarrier and Power allocation are done for the available users in the channel, so that the

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result is improvised available channel usage in the transmission. The simulated result which illustrated the power performance of OFDMA by considered the PSNR and PAPR in order to reduce the power consumption and to increase the efficiency of resource allocation. The management of interference also carried in this work which mentioned the clear data about how much power is allocated for each subcarrier along with the CSI and how much noise is adhered with the allocated power amount for randomly considered number of input bit streams. Finally, this model efficiently evaluated the overall capacity of channel for the resources which allocated for the transmission by using the water drifting algorithm. From Tab 4.6 comparison, it stated that the actual CSI value, 1.0221 which is observed for the OFDM signal, lies within the range of estimated CSI value of 2.0917 it can iterated the value of 2.0961 as maximum, which means the interference is in manageable condition. However, the future work will concentrate on the video transmission in the cognitive radio networks by using OFDMA interference technique, as a protocol along with the resource management technique by concealing the four layers of CRN for lowering the delay in the real time communication.

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