Genetic Based Multi Objective Optimization for OFDMA System Analysis

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Abstract : In This Paper We Consider Pre-Coder Based Peak Power Reduction For OFDMA Broadcast System Under The Constraint That Each Symbol Are Mutually Coupled With Considerable Qos. The Motivation For This Is That To Carry Out Power-Reduction And Jointly Considered With BER Reduction Schemes In Large-Scale OFDMA Systems. MATLAB Simulation And Numerical Results Show That, BER Conditions On The Channel Gains, A Novel Pre-Coded Scheme Systems Produced Optimized Performance Results With Threshold Scheme The Inherent Peak-To-Average Power Ratio (PAPR) Problem Is Mitigated. This Key Idea Is Extend To Propose Genetic Scheme Where The Objective Function Is Iteratively Performed With Improved Fitness Evaluation. Experimental Results Show That Genetic Scheme Outperforms All Other State-Of-The-Art Methods In Terms Of BER Rate With The Maximum PAPR. Here We Compare Both BET Simulation Results And CCDF Power Levels To Validate The Optimization Models Over Multi User Environments And Its Computational Complexity Reduction Is Proved Against Conventional Other Scheme.
Keywords - Genetic Algorithm (GA), Peak To Average Power Ratio (PAPR), Orthogonal Frequency Division Multiple Access (OFDMA).

I. INTRODUCTION

ORTHOGONAL Frequency-Division Multiple Accesses (OFDMA) Has Become Very Popular In Wireless Communications. After Its Adoption In The Recently Developed Wireless Local Area Network (LAN) And Broadband Wireless Access (BWA) Standards ([1], [2]), This Technique Is Seen Today As A Strong Candidate For Future Generations Of Cellular Mobile Networks. In Current Systems, OFDMA Is Used With Time-Division Multiple Access (TDMA), I.E., Users Sequentially Share The Available Radio Resources And All Carriers Are Assigned To The Same User During A Given MCCDMA Symbol. OFDMA Can Be Viewed As A Collection Of Transmission Techniques. When This Technique Is Applied In Wireless Environment, It Is Referred To As DFT Pre Coded OFDM. In The Wired Environment, Such As Asymmetric Digital Subscriber Lines (ADSL), It Is Referred To As Discrete Multi Tone (DMT). In OFDM, Each Carrier Is Orthogonal To All Other Carriers. However, This Condition Is Not Always Maintained In DMT [1]. OFDMA Is An Optimal Version Of Multi Carrier Transmission Schemes. OFDM Started In The Mid 60's, Chang Proposed A Method To Synthesize Band Limited Signals For Multi Channel Transmission [2]. The Idea Is To Transmit Signals Simultaneously Through A Linear Band Limited Channel Without Inter Channel (ICI) And Inter Symbol Interference (ISI) .

Multi-Carrier Modulation

Instead Of Transmitting The Data Symbols Serially, The Multi-Carrier Transmitter Partitions The Data Into Blocks Of N_c Data Symbols That Are Transmitted In Parallel By Modulating The N_c Carriers. The Symbol Duration For A Modulated Carrier Is $T_s = 1/W$.
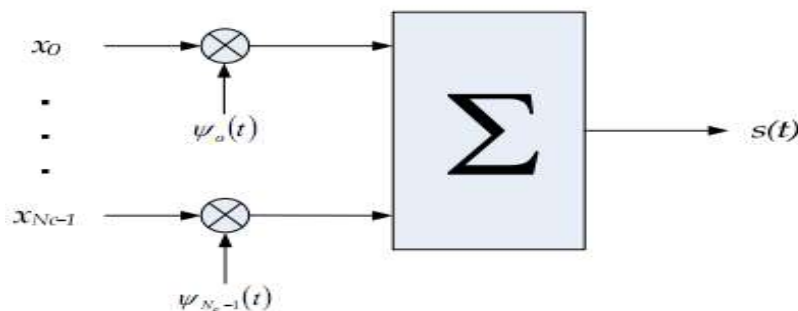

Fig. 1: Multi-Carrier Modulation

A Number Of Steps Can Be Taken When Designing A Multi-Carrier System To Mitigate The Effects Of Fading.

In Time Domain, The Data Symbol Duration Can Be Made Much Longer Than The Maximum Excess Delay Of The Channel. This Can Be Done Either By Choosing Max Ts >>Tmax .

In Frequency Domain, The Bandwidth Of The Sub-Carriers Can Be Made Small Compared To The Coherence Bandwidth Of The Channel Bcoh >>W/Nc. The Sub-Bands Then Experience Flat- Fading, Which Reduces The Equalization To A Single Complex Multiplication Per Carrier.

II. OFDMA SYSTEM MODEL

The Word Multiple Access Indicates That There Is A Precise Mathematical Relationship Between The Number Of The Carriers And Number Of Concurrent Users Acquired That System. In A Normal Frequency-Division Multiplex System, Though Many Sub Carriers Are Spaced Only One Users Can Able To Accommodate Using Conventional IFFT Transform.

2.1 PAPR IN OFDMA

One Of The Main Disadvantages Of The OFDMA Systems Is The High PAPR Of The Transmitted Signal Due To The Combination Of N Modulated Scs. The PAPR For A Continuous-Time Signal, X(T), Is Defined As:

$$\mathrm{PAPR} = \frac{\max\{|x(t)|^2\}}{E\{|x(t)|^2\}}, \quad 0 \leqslant t < T_u.$$

On The Other Hand, The PAPR For Discrete-Time Signals Can Be Estimated By Oversampling The Data Sequence D Depicted In Fig. 2.3 By A Factor L And Computing LN-Points IFFT Of The Data Block With $(L-1)N$ Zero-Padding. The PAPR In This Case Is Defined As:

$$\mathrm{PAPR} = \frac{\max\{|x_n|^2\}}{E\{\|\mathbf{x}\|^2\}}, \quad n = 0, 1, \cdots, LN - 1,$$

2.2 CCDF Of The PAPR

The CCDF Is Widely Used To Assess The Performance Of PAPR Reduction Techniques Which Is Defined As The Probability That The PAPR Is Greater Than A Reference Value Denoted As PAPR0. Fig. 3.1 Depicts The CCDF Of The PAPR Of The OFDM Signals With N = 1024 Scs And Different Oversampled Factor, L = 1, 2 And 4. It Is Clear That The PAPR Does Not Increase Considerably After L = 4. Therefore, An Accurate PAPR Estimation For The Discrete Model Requires An Oversampling Factor L > 4. It Has Been Shown That The Difference Between The Continuous-Time And Discrete-Time PAPR Is Negligible For L = 4 [12].

A Straightforward Estimated Expression For The CCDF Of The PAPR Of An OFDM Signal Is With A Large Number Of Scs And The Real And Imaginary Parts Of N-Point IFFT Output Samples Have A Mutually Independent And Uncorrelated Gaussian Probability Distribution Function With Zero Mean And A Variance Of Σ2 = E{|Xn|2}/2.

F(Z) = 1 − Exp(−Z).

Furthermore, The CCDF Of The PAPR Can Be Given By,

CCDF = Pr(PAPR > PAPR0) = 1 − F(PAPR0)N = 1 − (1 − Exp(−PAPR0))N.

Dynamic Channel Allocation In OFDMA Transmission Scheme Advantages

- Makes Efficient Use Of The Spectrum By Allowing Overlap.
- By Dividing The Channel Into Narrowband Flat Fading Sub-Channels, OFDMA Is More Resistant To Frequency Selective Fading Than Single Carrier Systems Are.
- Eliminates PAPR Problems (ISI) Through Use Of Successive Channel Allocations.
- Using Adequate Channel Coding And Interleaving One Can Recover Symbols Lost Due To The Frequency Selectivity Of The Channel.
- Channel Equalization Becomes Simpler Than By Using Adaptive Equalization Techniques With Single Carrier Systems.

It Is Possible To Use Maximum Likelihood Decoding With Reasonable Complexity, OFDMA Is Computationally Efficient By Using FFT Techniques To Implement The Modulation And Demodulation Functions

III. Proposed Optimization Model

The Proposed Pre Coded Model Will Calculate The PAPR Rate Grid By Each Allocation Grid And Identify The Best Location For Deploying The Modulated Symbols. The Grid Size Can Be Determined According To The Constraint Of Computational Cost. A Larger Grid Will Reduce The Computational Cost But Will Find A Location With Lower Network Capacity. It Gives An Example Where The Candidate Region Is Partitioned Into Several Grids And A Location Will Be Identified For Deploying The Relay For Achieving The Maximal Network Capacity.
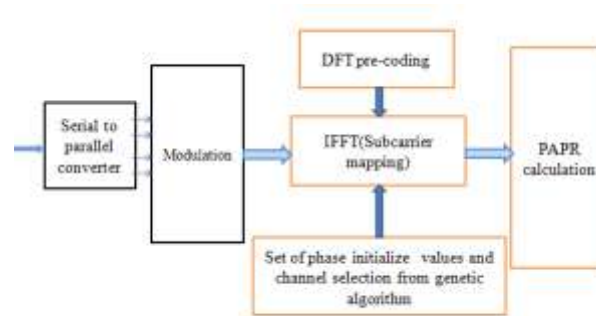
Fig. 2. Proposed Parametric Optimization Model

STEP1: Partition The Region Into Equal Size Of Sub Regions.
STEP2: Deployed PAPR Calculation In Each Partition
STEP3: For (I=1:No.Of Sub Regions)
      If (Pi Is Closer To BS)//Pi Relay Placement Location
       Skip:
     Else;
       Set Low Faded Bright Region
STEP4: For All Possible Sub Carriers In Bright Region: Select Point Which Leads Maximum Network Capacity.
      Evaluate Its PAPR.
SETP5: Change The Channel Allocation Order Based On Its Metrics.

3.1 Genetic Optimization Model

Required PAPR And BER Rate Is Accomplished Through Appropriate Gene Selection And Its Time Domain Signal Using An Inverse Fourier Transform.

IV. Chromosomes

The Original Motivation For The GA Approach Was A Biological Analogy. In The Selective Breeding Of Plants Or Animals, For Example, Offspring Are Sought That Have Certain Desirable Characteristics— Characteristics That Are Determined At The Genetic Level By The Way The Parents' Chromosomes Combine. In The Case Of Gas, A Population Of Strings Is Used, And These Strings Are Often Referred To In The GA Literature As Chromosomes.

The Recombination Of Strings Is Carried Out Using Simple Analogies Of Genetic Crossover And Mutation, And The Search Is Guided By The Results Of Evaluating The Objective Function F For Each String In The Population. Based On This Evaluation, Strings That Have Higher Fitness (I.E., Represent Better Solutions) Can Be Identified, And These Are Given More Opportunity To Breed. It Is Also Relevant To Point Out Here That Fitness Is Not Necessarily To Be Identified Simply With The Composition F(C(S)); More Generally, Fitness Is H(F(C(S))) Where Is A Monotonic Function.
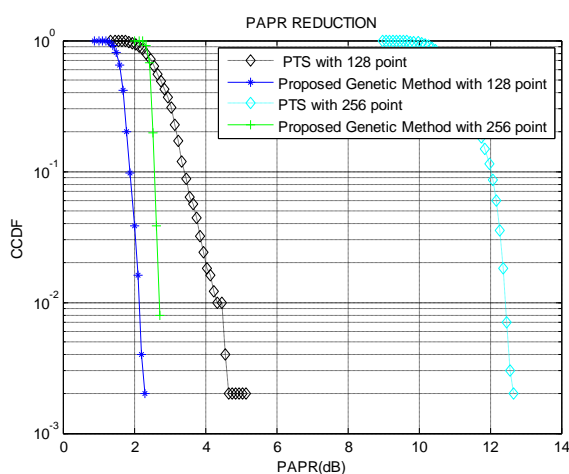
V. Performance Analysis

In This Section, We Present MATLAB Simulation Results To Illustrate The PAPR Reduction Performance Of Both Precoder And Genetic Scheme. For BER Analyses The MS Is Equipped With Higher Order Mapping And Serves M = 16 Pre Coding Is Employed To Avoid The MUI. Moreover, The Complementary Cumulative Distribution Function (CCDF) Is Employed To Show The Statistical Properties Of PAPR. In Order To Make The Peak Power Fully Reduced, We Propose Genetic Scheme To Iteratively Perform With The Maximum PAPR As Shown In Fig 2. The Pre Coder Scheme Only Reduces The Peak Power On Low Size FFT, Resulting In Much Higher Complexity Than The Genetic Scheme. With A Part Of The Saved

Computational Resources, The Genetic Scheme Could Continue To Reduce The Peak Power Iteratively. Thus, The BER Reduction Can Also Achieve With Better PAPR Reduction Performance Than The Pre Coded Scheme With Lower Complexity As Shown In Fig 3.

Table 1. Comparative Performance Analyzes Of Genetic Based Model

Optimization model	AREA	Fmax report
Pre-coded MATRIX	305	297.71 MHz
Genetic model	275	318.17 MHz

Since Genetic Consider Generate All Possible Combinations Of Weighting Factor Set In The IFFT Block And Both BER And PAPR Optimization Is Combinely Achieved. Finally The Merits Of Genetic Based Model For Parameter Optimization Over Precoded Matrix Model In Terms Of Iterative Complexity Reduction And Performance Is Proved As Shown In Table 1.

Fig. 3: Pre-Coder Vs. Genetic PAPR Analyzes Over Various IFFT Sizes.
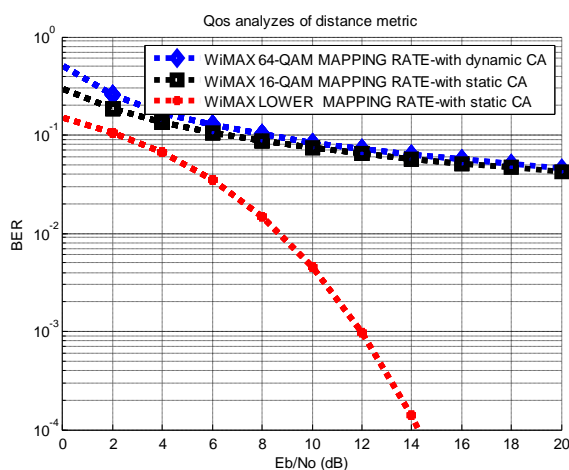
Fig. 4: BER Performance Analyzes Using Dynamic Channel Allocation.

VI. CONCLUSION

In This Thesis, We Carried Out Performance Metrics Of Genetic Scheme Over BER Reduction With Maximum PAPR Reduction In OFDMA Systems. In Most Cases The PAPR Of OFDMA Systems Mainly Depends On The Maximum PAPR Of All Transmit Symbols, The Proposed Pre-Coded Scheme Can Able To Achieve Significant PAPR Reduction With Low Complexity. In Simulation Results We Proved That The Genetic Scheme Achieves Better PAPR Reduction With Lower Complexity Than The All Other Existing Pre Coded Scheme. The Concept Of Multi Objective Optimization And Variations That Have Been Noticed Is Consistent In Genetic Approaches With Appropriate Initialization Methods, Fitness Definition, And Selection

And Are Obviously Replacement Strategies Used In Crossover And Mutation. We Can Add Information Such As Age, Or Artificial Tags, To Chromosomes; In Order To Reduce Complexity Further.

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