Integrating Range Decoder with MIMO STBC HARQ System

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Abstract

As an expansion of the third era of versatile correspondence framework. The Inter Cell Interference (ICI) is two components which constrains the show of remote cell systems. In the literatures different frequency reuse schemes have been proposed to overcome above limitations. One of the accepted methods is Soft Frequency Reuse which effectively controls the spectrum management and reduces the ICI for wireless networks. In regular static Soft Frequency Reuse (SFR) plot, transmission control in cell and designation of subcarriers are settled amid the framework organization, which influences the execution of framework. This paper centers intercell asset portion calculation, which is dynamic in nature and upgrades both subcarrier and transmission control for cell arrange which results in more noteworthy enhancement in information rate and framework limit.

Index Terms*: Inter Cell Interference (ICI), static Soft Frequency Reuse (SFR), Space Time Block Codes (STBCs), Sphere Decoder (SD).*

INTRODUCTION

The enormous and ever increasing growth of mobile subscribers and their demand for increase in data rate indirectly increases demand of the spectrum size, but unfortunately the wireless spectrum allotted to each radio systems are limited and further they are costly. In this way higher framework limit and information rate prerequisite are the two fundamental planning limitations for new and up and coming remote cell systems like LTE [5] and LTE-Advanced (LTE-A) [6]. The optimum detection method is the Maximum Likelihood (ML) detection[2]. However in MIMO systems, ML algorithm has an exponential complexity with the constellation size and the number of antennas[3]. In the event that signals are transmitted on same recurrence from neighboring cells there is a potential outcome of ICI for cell edge client i.e. clients situated at limits of cells. This is the fast detection approach for received signals. It reduces the complexity for received signals and less time consuming.

DESCRIPTION

Quadrature Phase Shift Keying (QPSK) Modulation

Single cell resource allocation is to maximize cell's throughput by finding major and minor subcarrier and their power with prerequisite of resource allocation information in adjacent cells. In initial step, locate the base transmit control that can be utilized to fulfill the virtual client's information rate necessity, in second step reallocate remaining force so that cell throughput is expanded and these means are rehashed until the point that cell's throughput accomplishes steady rate.

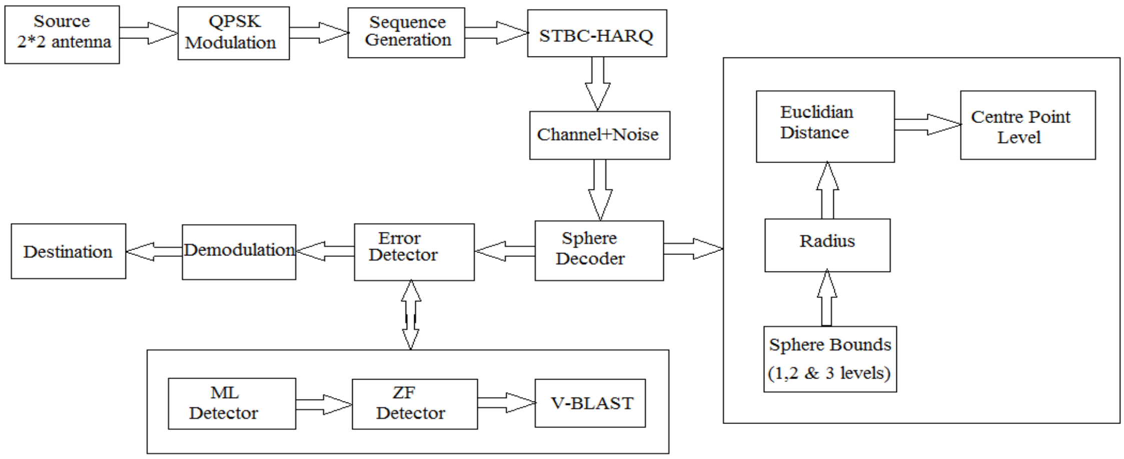

***Fig: 1.** Block Diagram*

Space-time block coding

This technique is used in wireless communication to transmit multiple copies of data using multiple transmitting & receiving antennas without any bandwidth expansion to improve the data transfer reliability. The transmitted signals may be affected with some atmospheric disturbances. Although there is redundancy in the data some copies may arrive less affected at the receiver. The system throughput optimization is constraint to lower bound of minimum data rate and maximum transmit power of each base station. In Figure 1, Space Time Block Coding is done in the transmitter side. Two signals y_1 and y_2 are transmitted simultaneously from the antennas T_{y1} and T_{y2} in the time slot T_1, and the signals $-y_2$ and y_1 at the time slot T_2. As a result, now decrease the number of major subcarriers that assigned in the initial allocation step which are required to satisfy cell exterior users for data rate requirement. These two signals are passed to the combiner. Simple signal processing is done in the combiner to separate the signals aided by the channel estimator which will provide perfect estimation of the channel.

Hybrid Automatic Repeat request (HARQ)

In standard Automatic Repeat ask for (ARQ), excess bits are added to transmitted information utilizing cyclic repetition check (CRC). If the receiver does not receive the message properly then it will request a new message from the sender. This feedback message is known as the acknowledgement (ACK) (may be positive or negative). The retransmissions take place until the data bits reach the destination properly without any error. The performance of the data flow would be much better if there were no retransmissions so HARQ technique is used. Randomly select non overlapping subcarriers for cell interiors that fulfill In the Soft Combining technique, the data that is not decoded properly is not discarded but it is stored in a buffer and will be combined with next retransmission.

The system data rate, subcarrier and power allocation during iterative process is continuously monitored.This technique creates a Forward Error Correction (FEC) code which is used in HARQ to encode the original data. Two cases are possible in sending the parity bits. When the receiver detects an error in the message, then negative acknowledgment has been sent to the sender which then sends the parity bits or initially the message is combined with the parity bits.

*D.*Range Decoder subject to the target data rate constraints of the virtual cell interior and cell edge users. Euclidean distance is the ordinary distance between two points in Euclidean space (3D plane). The radius R should be chosen properly. If the radius too small then it results in an empty sphere and then starting the search again. Simultaneously if the radius is too large then it increases the number of lattice points which are to be searched.

Approach

Mathematical Approach - of a cost function f(x1,……..,xk) with respect to its K arguments taking value in a discrete set of cardinality L.

The system throughput optimization is constraint to lower bound of minimum data rate and maximum transmit power of each base station, the mathematical formulation can be concluded as,

Principle - The distance is seen as a sum of non-negative functions with an increasing number of arguments

d=f(x1,…,xk)=h(xk)+h(xk,xk-1)+….+h(xk,…,x1)

determine the optimum number of major and minor subcarriers and their respective transmit power to minimize the total base station transmit power, subject to the target data rate constraints of the virtual cell interior and cell edge users. The formulation can be written as

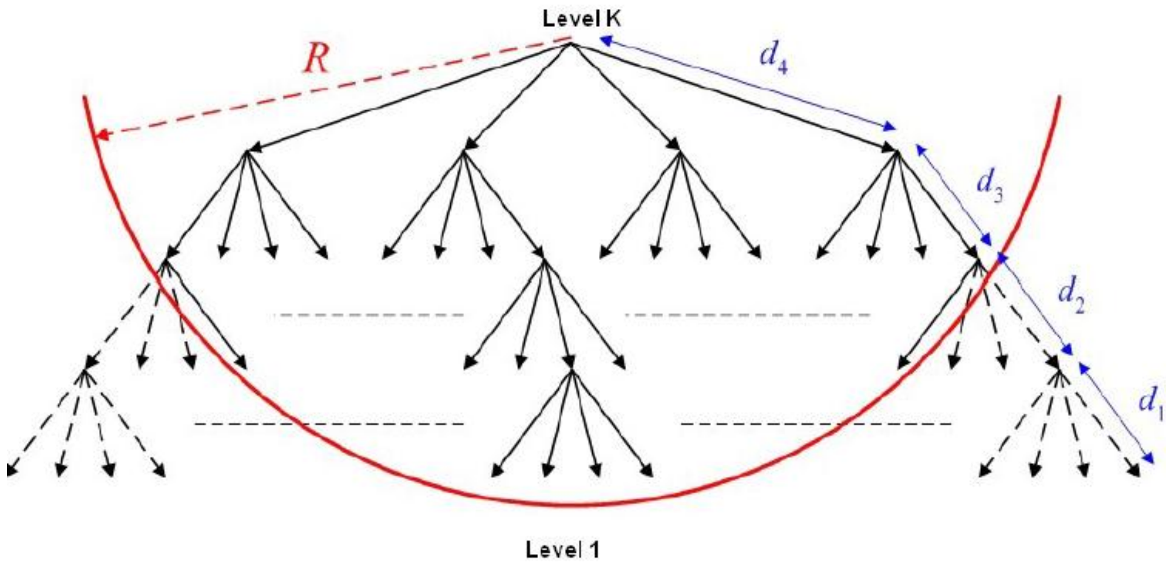

Fig: 2. *Subsets of data bits in a hyper sphere*

R – Radius of hyper sphere
d1, d2, d3, d4 – Euclidian distance
K – Level of Sphere partition

Algorithm:

There are two stages:

1. Initialization:

- At level K – smallest intermediate value leads to L next nodes at level (K-1) + (k+1).
- At level (K-1) – smallest value among the L nodes and so on until the level 1, (k+1).
- Sum of the K values give the starting radius u0.
- It is the exploration of the other branches.
- Each branch which will certainly give a higher uo is pruning out.
- If a leaf is reached with a smaller sum than uo, uo is updated with that new value. This process continues until all branches have been pruned out.

Zero Forcing (ZF) detector uses inverse filter to amplify noise which results in noise enhancement. This leads to poor bit error rate performance. So ZF detector is replaced by V-BLAST (Vertical Bell

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Laboratories Layered Space Time) detector in which the strongest signals are decoded first and then they are subtracted from the received signals. This process continues until all the received signals are decoded. But Error propagation is a problem in this detector because if the incorrect decisions are taken then that actually increases the interference. So V-BLAST is again replaced by Maximum Likelihood (ML) detector which determines the minimum Euclidean distance of Sphere decoder (SD). When immersion of framework information rate is accomplished, major and minor subcarriers and their individual power likewise soaks to their relating esteems. Otherwise the ML detector has to test all the possible received signals. As the number of antennas and constellation order increases it becomes quite difficult for this detector to extract the signals.

SIMULATION

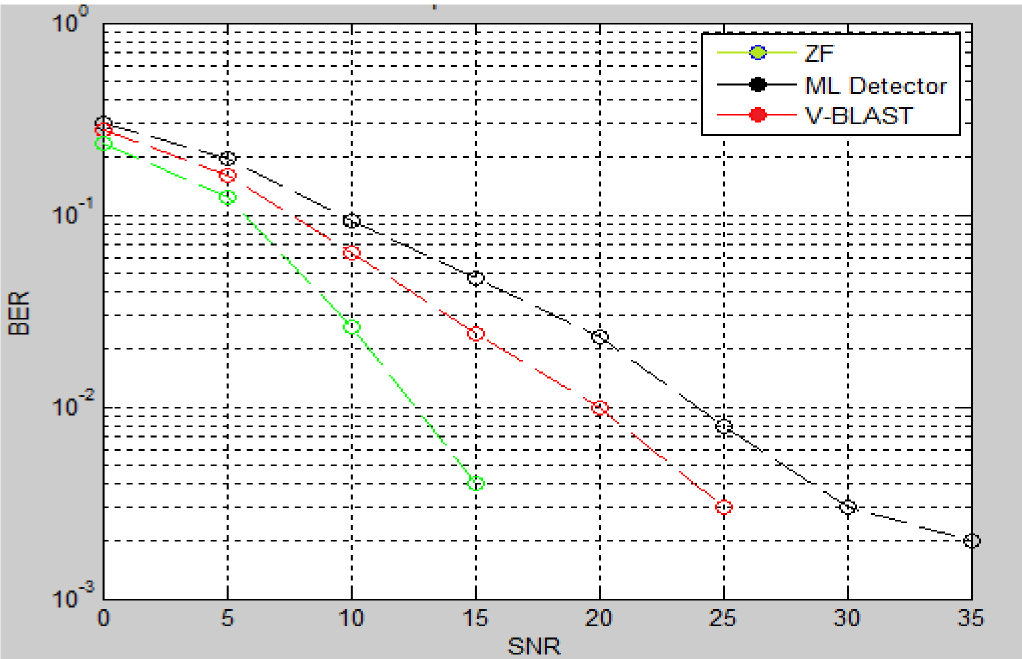

Fig: 3. *Comparison of SNR versus BER for three detectors (ML V-BLAST, ZF)*

Initialization: Let $D_1^{VE_{tar}}(0) = D_1^{VE_{min}}$, $D_1^{VC_{tar}}(0) = D_1^{VC_{min}}$ and repetition count n=0

1. For each pair of subcarriers that fulfils (8e) and (8d),find the respective major and minor subcarrier power according to (12) and (11) that satisfy $D_1^{VE_{tar}}(n)$ and $D_1^{VC_{tar}}(n)$.
2. Next step is to evaluate total power P_1 for each subcarrier pair by using (7) and require to find $P_{min}(n) = min(P_1)$
3. If $P_{min}(n) < P_{max}$, go to step 6,
4. If $P_{min}(n) = P_{max}$, go to step 7,
5. If $P_{min}(n) > P_{max}$, terminate the algorithm.
6. This is resource allocation step, where $P_{min}(n) < P_{max}$ we need to set $L_1^{major} \leftarrow L_1^{major} - 1$,then reassign major subcarrier's power and finally set $L_1^{minor} \leftarrow L - L_1^{major}$ repeat this step until condition $L_1^{minor} p_1^{minor} + L_1^{major} p_1^{major} > P_{max}$ to be achieved.
7. Calculate cell interior data rate and reassign cell interior data rate requirement.
8. Increase the repetition count by 1, furthermore we need to follow step1-7 until cell data rate maintains constant value.

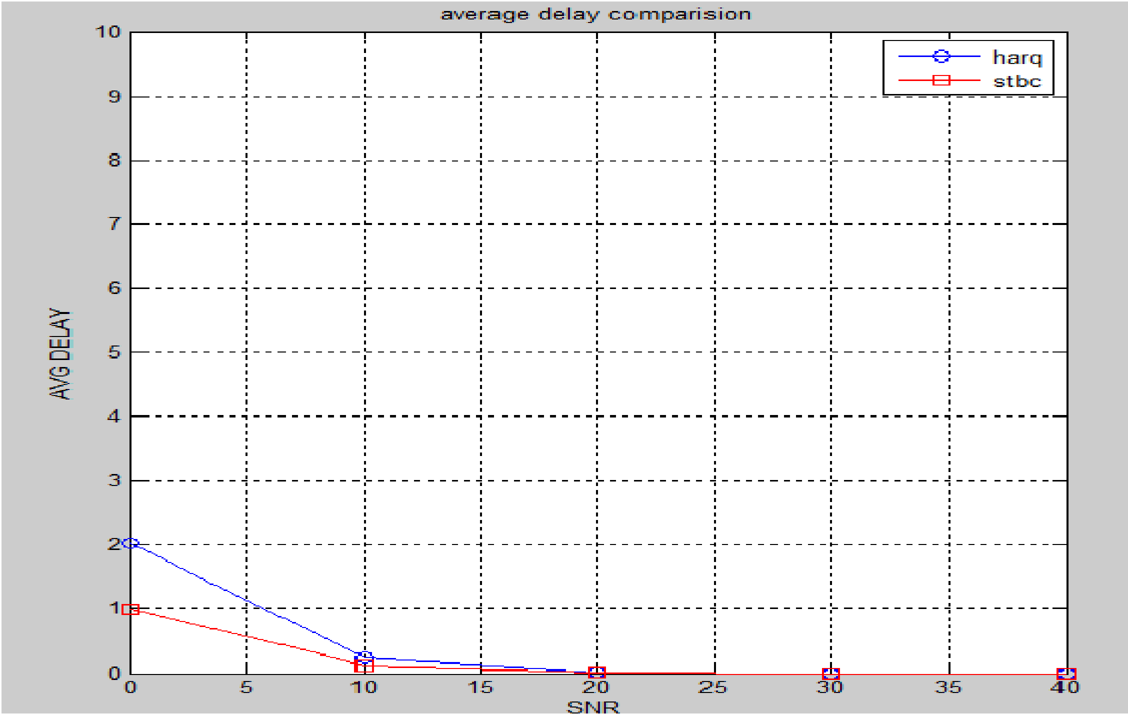

Fig: 4. *SNR versus average delay comparison for STBC and HARQ Systems*

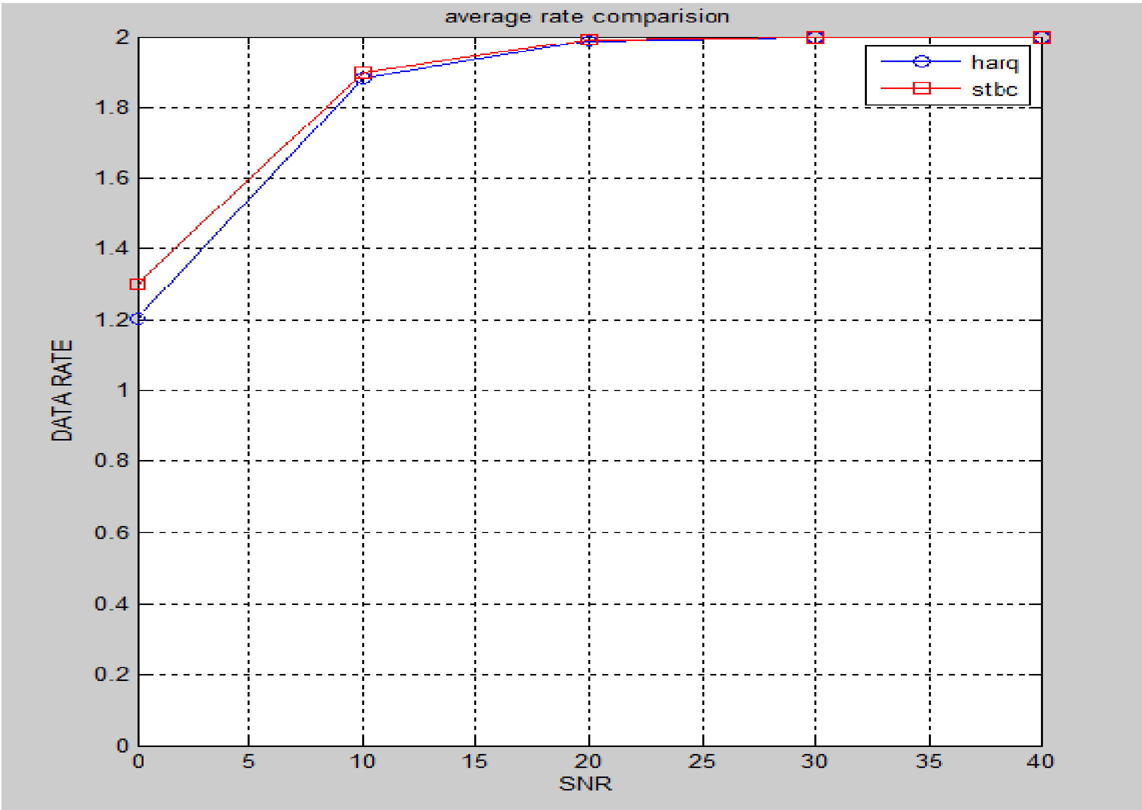

Fig: 5. *SNR versus average data rate comparison for STBC and HARQ Systems*

In Figure 3, the SNR versus BER of the decoded information is showed by the comparative study of 3 schemes. The first scheme ML detector is used in receiver side to calculate BER. The another term to be considered as framework information rate which is total of information rates of virtual clients in every executed cell, formulated as, $D_{SUM}^{tar} = \sum_{j \in C} \left(D_j^{VC_{tar}} + D_j^{VE_{tar}} \right)$, for j cell. In Figure 4, the SNR is compared with average delay of STBC and HARQ Systems in which the STBC is comparatively good than HARQ for the reduction of delay. In Figure 5, the SNR is compared with average data rate of STBC and HARQ Systems in which both HARQ and STBC achieves same SNR but the data rate is slightly higher for STBC when compared to HARQ.

CONCLUSION

The proposed adaptive second tier soft frequency reuses algorithm works in physical layer by iteratively optimizing subcarriers count and power allocation. In the Sphere Decoder this problem has been solved by splitting the information into levels using radius selection algorithm in which the information is decoded simultaneously in different levels. The performance of Sphere Decoder is better in terms of SNR, BER with ML detector. Finally, Combined optimization of both subcarriers and their transmission power in distributed fashion in SFR, which is under constraints of data rate requirement in each individual cell regions to enhance the system data rate with system capacity.

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