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Resource Allocation In Wireless Networks By Channel Estimation And Relay Assignment Using Data-Aided Techniques

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Abstract

MIMO-OFDM is the recently developing channel estimation technique for achieving high speed and reliable communication. The resource allocation in wireless communication is analysed by using channel estimation technique. Pair of users communicates each other through multiple two way relays in orthogonal frequency division multiplexing modulation transmission systems. The total throughput is maximized by data-aided estimation technique using relay selection, channel and relay assignment. The set of most reliable data carriers among the relays is determined using this data aided estimation technique. The evaluation of the network total throughput with respect to transmit power node and the number of relay nodes are analysed through simulation. In this work, the improvement in sum rate with optimum carrier assignment using proposed algorithm is demonstrated against the classical work.

Keywords: Resource allocation, Relay selection, Carrier assignment, Throughput Maximisation.

1. Introduction

Orthogonal Frequency Division Multiplexing (OFDM) is a multi-carrier transformation strategy in which high rate information stream is isolated into various sub-bearers of lower rate information streams. Subsequently, OFDM System is likewise alluded to as tweak procedure. Productive tweak procedures are fundamental to regulate higher rate single information stream into various lower rate information streams. Vast attempts have been proposed the distinctive sorts of advanced regulation, for example, Amplitude Modulation (Both Amplitude Shift Keying (ASK) and Quadrature Amplitude Modulation (QAM)), Phase Shift Modulation (Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK), and Quadrature Phase Shift Keying (QPSK)). Overall stage move balance gives better exhibitions as far as VLSI worries than abundance balance, in light of the fact that in stage move tweak, diverse number of stage move serves to effectively balance the data sources. In any case, the speed of sufficiency regulation expanded than stage move based tweak.

One of the promising techniques to attain the incorporation of correspondences framework for communications system is OFDM. The fixed OFDM has more intricacy in data flow path. Also, it has hardware complexity for the speed of fixed OFDM with the data flow or information. Adaptive OFDM (AOFDM) is introduced in [1] to overcome the complexities. Performance improvements of AOFDM can be measured in terms of Bit Error Rate (BER) and throughput. Spectral efficiency of the input signals is to be considered to increase the performances of BER. In [2], the procedure for raising the spectral competence with the help of adaptive modulation and coding rate techniques is explained in brief. The main aim of those works is reducing the BER rate for OFDM based communication system. The adaptive modulation system is projected based on Signal to Noise Ratio (SNR) value. Adaptive Modulation and Coding (AMC) helps to get better competence of Channel State Information (CSI) and maximize the throughput with better spectral efficiency. For the application of cognitive radio system, spread spectrum (SS) and Multi-carrier Spread Spectrum (MSC) are recognized as a high potential. Hence, therefore adaptive modulation is crucial to recover the spectral description of cognitive radio system. Further, adaptive modulation based OFDM system can be extended for Multi-In-Multi-Out (MIMO) OFDM application.

2. Related Works

Several strategies for reducing the complexities of MMSE estimator was proposed in massive MIMO have been proposed. Channel estimation of flat and frequency selective channels for SISO and MIMO systems have been studied extensively using minimum mean square error (MMSE) estimator. The method is complex and therefore, a number of approaches, such as [3-5] have been developed to reduce its complexity but little drawbacks are still exists. Particularly, by employing large number of antennas at the BS, significant number of channel coefficients has to be estimated. Hence, MMSE-based methods are converted into impractical as high dimensional matrices those are need to be inverted. Hence further investigations should be carried out for low complexity channel estimation approaches tailored for multi-cell and multi-carrier massive MIMO systems.

In [6] the proposed mechanism addresses digital communication over the channel characteristic which is unknown at the transmitter but known (tracked) at the receiver in a Rayleigh fading environment. Developing a codec engineering that can understand a noteworthy part of the considerable limit guaranteed by data hypothesis is fundamental to a champion long haul position in exceedingly aggressive fields like settled and indoor remote.

Compressive Sensing (CS) for the channel grid estimation issue was proposed for expansive scale of multiuser (MU) numerous info different yield (MIMO) frameworks [7]. The framework display incorporates a base station (BS) outfitted with countless discussing all the while with countless single-radio wire User Terminals (UTs), over a practical physical channel with limited dispersing model. A low-rank network estimate in view of CS is proposed and fathomed by means of a quadratic semi-define programming (SDP)

The authority of orthogonal and non-orthogonal pilot sequences on the system performance [8] is analytically characterized when each BS has infinitely many antennas in the existing work by following up the same setup in which MIMO cellular system where each base-station is capable of huge antenna array and serves some single antenna mobile stations. Closed-form expressions are derived using stochastic geometric modelling of the base station and mobile station spots for the distribution of signal-to-interference-ratio (SIR) for both uplink and downlink. Low-rank LMMSE channel estimator for MIMO-OFDM systems with low-complexity using comb-type pilots was proposed. The estimators make use of the subspaces and their relationship between the subspaces using frequency domain channels at the pilots and non-pilots subcarriers. Subspace monitoring has clearly shown that in the conventional system of Least Minimum Mean Square Error (LMMSE) channel estimation of MIMO-OFDM systems can be feasible..

The bottleneck in achieving the full advantages of massive MIMO is the accurate estimation of the channel impulse response (CIR) for each transmit-receive antenna pair. High computational complexity of LMMSE needs to be eliminated. Therefore data aided transmission is considered in the conventional LMMSE method.

3. System model with OFDM Architecture

By assuming that users of all chambers synchronously broadcast their OFDM data symbols in Time Division Duplex (TDD) fashion to their serving base station. The channel encoder encodes the input data then given to the modulator, amplitude modulation technique is used modulate the signal. Guard interval or delay spread is added at the transmitter section for ISI free transmission and removed at the receiver section and the signal is demodulated. Assume N number of OFDM sub-carriers and χ represent the N-dimensional information symbol and these entries are taken using bi-dimensional constellation (Q-QAM). By taking inverse Fourier the equivalent time-domain symbol is obtained i.e., $x=F^H\chi$ to avoid inter-symbol-interference (ISI). Once the guard interval or delay spread is inserted in to the transmitted sequence the time-domain symbol is then transmitted. At the receiver side the guard interval is discarded then the frequency-domain OFDM symbol at r^{th} antenna can be represented as ,

$$Y_R = Ah_R + W_R \tag{1}$$

where A is truncated matrix fashioned by selecting frequency domain noise vector of zero mean and covariance.

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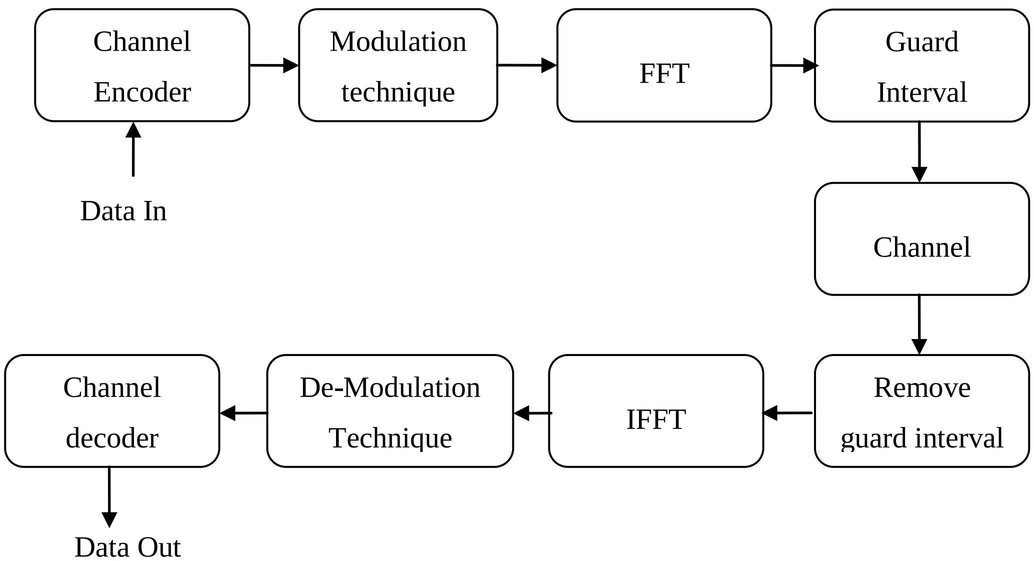

Figure. 1. OFDM Architecture

For a set of K pilot indices denoted by ρ, (4) reduces to

$$Y_R(\rho) = Ah_R(\rho) + W_R(\rho) \tag{2}$$

where $Y_R(\rho)$ and $W_R(\rho)$ are formed by choose the entries of Y_R and W_R indexed by while $A(\rho)$ is formed by choosing the rows of A indexed by ρ. The pilot observations of all antennas is collected into a vector,

$$Y_R(\rho) = [I_R \oplus A(\rho)]h_R + W_R(\rho) \tag{3}$$

where, Y(ρ) and W(ρ) are created by column-wise stacking of pilots and noise observations at each receiver antenna while I_R is an RxR identity matrix. Noise variance is assumed to be identical across the array.

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4. Data-Aided Estimation Technique Using Relay Selection

To improve channel estimates initially decoded data carriers is exploited and this initial channel estimates is obtained using pilots. Some of the data carriers are estimated as erroneous owing to noise and channel estimation errors and some of the data carriers are reliable as they are likely to be decoded correctly. Data aided estimator is used to identify the amount of noise present in the received signal. Certain amount of information or data is needed for estimation purpose which reduces the bandwidth efficiency. Additional throughput reduction is avoided by using pilot symbols which is linearly added to the transmitted data sequence.

To estimate channel conditions specified by the pilot signals and received signals with or without using definite information of the channel statistics. Estimated channel conditions are used in the receiver side to decode the received data inside the block until the next pilot symbol arrives. The estimation can be based on Least Square Method (LSM), Minimum Mean-Square Error (MMSE) and Optimal MMSE. Data aided estimation technique is used for channel estimation along with optimal MMSE

4.1 Reliable Data Selection.

The received OFDM symbol is considered at any antenna as shown in the equation 2 and let h_R CIR and CFR estimates obtained using pilots. The tentative estimates of the data symbols are obtained by equalizing the received OFDM symbol using zero-forcing (ZF) as follows,

$$\chi(\mathrm{k}) = y(\mathrm{k}) / \mathrm{H}(\mathrm{k}), \mathrm{k} \in \{1,\ 2,\ \ldots\ N\}$$

$$\approx \chi(\mathrm{k}) + \mathrm{W}(\mathrm{k}) / \mathrm{H}(\mathrm{k}) = \chi(\mathrm{k}) + \mathrm{Z}(\mathrm{k}) \qquad (4)$$

where Z(k) represents the noise or signal distortion on k^{th} data-carrier may be caused due to channel estimation error. Z(k) can be modelled as Gaussian noise with zero mean and variance. The healing of erroneous data symbol is performed later by utilising the simple hard decisions on estimated data symbols. Therefore the errors in the decoding process occur due to both inaccuracies of channel estimates as well as noise. Due to these distortions some of the data carriers might be severely affected and fall apart estimated decision regions. The data carriers χ(k) which satisfies the condition <~χ(k)> = χ(k) are selected as the most reliable carriers. Therefore the most reliable data carriers for the subset of R can be determined using equation (5),

$$R(\mathrm{k}) = f_z\left(\chi(\mathrm{k} - \langle \chi(\mathrm{k})\rangle\right) \qquad (5)$$

Algorithm for Data Aided optimal MMSE:

Step1: Every antenna acts as a central element and do channel estimates
Step2: Every antenna uses its CIR estimate then calculates noise and erroneous data symbol
Step3: Update the channel estimated values and error covariance
Step4: Apply simple hard decisions Z(k) on estimated data symbol.
Step5: Check whether the condition <~χ(k)> = χ(k) satisfies
Step6: Select R(k) as reliable data carriers

The reliable data carriers are chosen by keeping channel impulse response as a main component. The erroneous data and additive Gaussian noise carriers can be eliminated using the condition χ(k)>0 during the selection of reliable carriers.

5. Simulation Results

The simulation analysis of proposed system for channel estimation is conducted using the tool Network simulator-2 and the performance is measured. The nodes receives signal from all direction by using the Omni directional antenna. The parameters such as achievable signal rate, Signal to noise ratio (SNR) and bit error rate are measured for the system with reference to the conventional system.

5.1 Achievable Rate Vs SNR

The signal received rate is defined as the achievable bit or data rate at the receiver side. It can be calculated using the ratio of SNR and achievable rate.

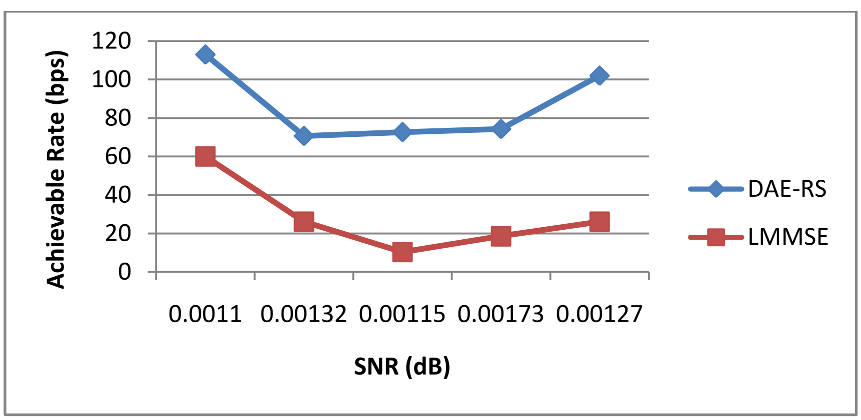

Figure. 2 Achievable rate Vs SNR

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5.2 Bit Error Rate

The Bit Error Rate (BER) is the number of bit errors occurred per unit time. BER is also defined as the number of bit errors divided by the total number of transferred bits during a studied time interval. Here the number of channel is considered for which the bit error rate is computed for each number of channels.

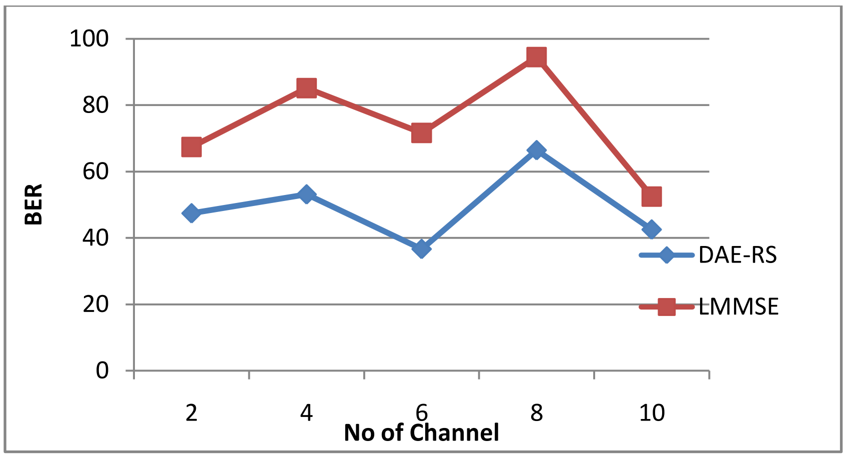

Figure. 3 BER Vs channel

6. Conclusion

MIMO-OFDM is the recently developing channel estimation technique for achieving high speed and reliable communication. The resource allocation in wireless communication is analysed by using channel estimation technique. Pair of users communicates each other through multiple two way relays in orthogonal frequency division multiplexing modulation transmission systems. The total throughput is maximized by data-aided estimation technique using relay selection, channel and relay assignment that relies on finding a set of most reliable data carriers among the relays. The evaluation of the network total throughput with respect to transmit power node and the number of relay nodes are analysed through simulation. In this work, the improvement in sum rate with optimum carrier assignment using proposed algorithm is demonstrated against the conventional algorithm..

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