A Novel Channel Estimation and Equalization Technique for Two-Way MIMO Relay Communication System

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Abstract: ***In recent years the MIMO relay systems are more attracted. The MIMO relay system can maximize the mutual information between the source and destination. For all MIMO relay system the individual channel state information to be estimated. This paper introduce a technique for the efficient channel estimation. Superimposed training and pilot sequences estimate the channel and the equalizers are introduce to reduce the errors. The optimal power allocation is obtained by minimizing the MSE.***

Keywords: Channel estimation, decision feedback equalizer, MMSE, Training sequence

1. Introduction

The MIMO relay systems are widely used in communication system. The nodes exchange their information through relay node and can increase the spectral efficiency. In one way MIMO communication the signal is transmitted from one source node to the destination node. In the two-way relay system two nodes exchanges and can provide high spectral efficiency. The MIMO relay system needs the instantaneous channel state information knowledge for extracting the source signals at the destination node.

The training sequences can be used to estimate the individual CSI of first and second hop links for two way MIMO relay system in frequency-selective fading environment. The training sequences are some random sequences. For the better transmission the false estimation should be avoid and power should be optimally allocated.

The optimal power allocation is done by minimizing the MSE. This paper introduce the method for the estimation. The decision feedback equalizers are used to avoid the ISI. The convolution codes to minimize the MSE. Since the convolution codes can detect and correct errors. The errors are reduced by avoiding the false estimation through superimposing pilot sequences.

2. Related Work

High rate and reliable wireless communication uses the multiple input and multiple output system. The optimal relay pre-coding matrix[1] for a three node two hop MIMO relay communication system has been developed. The MIMO relay communication is extensively used. The relay pre-coding design problems are investigated.

The MIMO relay communication uses the amplify and forward protocol. So that it will first amplify and then forward the received signal. This AF protocol can be used for optimal power allocation[2]. This will give high signal to noise ratio. But this study focus only on the one-way MIMO and the instantaneous CSI is unknown. To extract the signal from the received one, the instantaneous CSI should be essential. For the instantaneous CSI estimation the least-square algorithm proposed.

For obtaining the individual CSI[6], ML criteria is developed. It is not a better method since designed for single antenna system. Superimposed channel training algorithm can proposed[3] for orthogonal frequency division multiplexing modulated one-way systems.

The existing system investigate the channel estimation problem for the two-way MIMO relay system by superimposing the training sequence. It is developed on the frequency-selective fading environment and achieved a better performance through optima power allocation by minimizing the MSE. But there is no any other technique implemented for the ISI reduction and error free transmission. The random training sequence can generate the false estimation.

3. System Model

In the MIMO communication the source node and the destination node exchange their information through multiple input multiple output relays. So the same information can be transmitted through different path. Then the loss of signal through one path will not affect the correct reception. The superimposed training sequence can estimate the individual CSI. The frequency-selective fading environment based algorithm can provide more better solutions.

The proposed system mainly uses the convolution encoder to minimize MMSE. It will give better power performances. The training and pilot sequences gives the correct estimation and avoid the false estimations. The convolution encoder can detect and correct the errors.

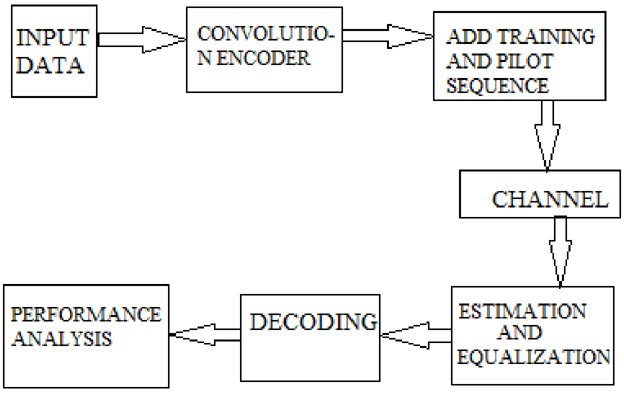

Figure 1: Block diagram of the system model

The block diagram shows the overview of the proposed system. The input data is some sample sequences. The power assigned in the transmission from source to relay and relay to destination. Then for reducing the errors the data to be encoded using the convolution encoder. The effective BPSK modulation scheme is used for the transmission. Then for the estimation the training and pilot sequence are superimposed. The training sequences are random sequence and pilots having fixed value. By using the training sequence find the delay of the faded signal. At the relay the received signal is amplified and again the pilot sequences are added. Then forward it to the destination. At the destination, after eliminating the sequences estimation is performed. The decision feedback equalizer is efficient in eliminating the ISI. So it is used in the equalization. After decoding the transmitted signal can be received and performances are analyzed.

4. Performance analysis

At the receiver after decoding the performance is analyzed. This is mainly from the MSE performances. The MSE is minimum for large value of power levels. Generally for the input x the output ,y will be

$$y = hx + n \qquad (1)$$

The received signal may contain the noise and is multiplied with the channel matrix. This may modified and is represented as

$$y = \varphi . h_N^p + W \qquad (2)$$

Here φ be the input sequences. The channel has some impulse responses. It will affected to the transmitted signal. The encoded date is added with training and pilot sequences. The relay uses the amplify and forward protocol. The again the pilot sequence superimposed and transmit through the channel.

The impulse response of the channel can be expressed as

$$h_l^i = \sum_{s=0}^{s-1} \alpha_s . \delta(l - \zeta_s), 0 \le l \le L-1 \qquad (3)$$

Here the path gain is α . Path delay and sampled path delay are δ and ζ_s.

MIMO relays transmit the signal in different ways. So that the multiple path will reduce the MSE. More multipath will give better performance.

Develop a MMSE based algorithm to retrieve the first hop channel matrices, which takes into account the estimation error inherited from the estimation of the second-hop channel matrices. Different MIMO uses different number of antennas. The antenna will be introduce errors, since here more parameters should be estimated. Strong signals having high power and MSE is reduced.

5. Simulation Results

The simulation results are used to study the performance of two-way MIMO relay system obtained from the analytical results. All nodes are equipped with same number of antennas, that is, $N_S = N_r = N$. For simplicity, we assume that all channel taps have unit variances. We use the shortest length of training sequence with $L = (5Q-2)N$. For all cases the MSE for nodes 1 and 2 are computed.

All the simulation results are compared with the existing system. The proposed system gives the better. Each plots will give the effect of NMSE. To get the correct signal, the power level should be high and error should be reduced. The figure 2 shows the performance comparison for different number of antennas. The graph is plotted with the power in y axis and NMSE in the x axis. The error free transmission gives high SNR. So that the MSE is less. As the power increases the NMSE decreases. But for large number of antennas the NMSE increases as more unknowns to be estimated. The proposed system gives better performance. The figure 3 shows the comparison for different alpha values. The MIMO relay uses the amplify and forward protocol. The alpha is the amplifying factor. Low NMSE with high power gives better performance. So that here highest amplifying factor leads to get the better performance. The optimal alpha curve is obtained by applying the GSS technique in the proposed algorithm. The optimal alpha curve consistently has the lowest MSE level for all P. This proves that the GSS technique is able to obtain the optimal alpha at different P efficiently.

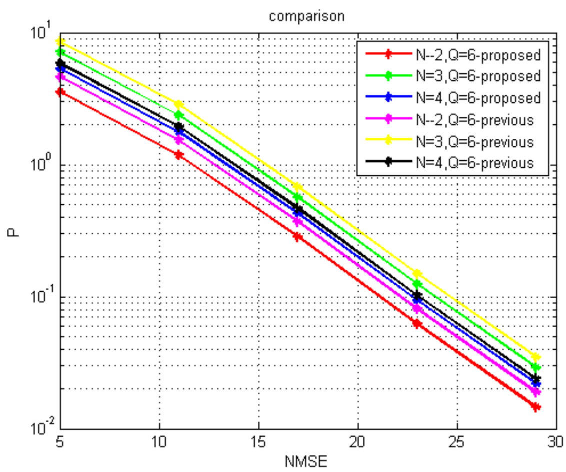

Figure 2: Performance comparison of existing and proposed for different values of Q and N

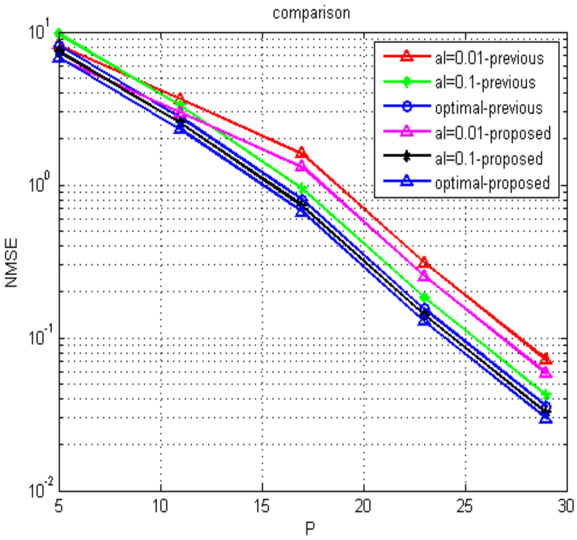

Figure 3: Performance comparison of existing and proposed system for different values of alpha

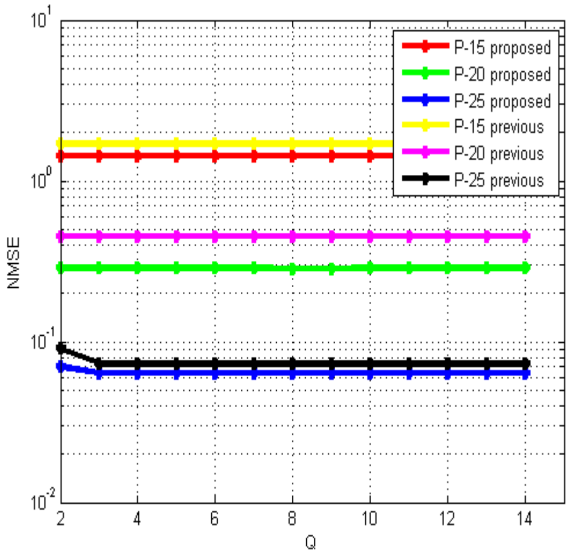

Figure 4: NMSE versus Q for different P

The figure 4 investigate effect of the number of multipath Q on the performance of the proposed algorithm. For more number of multipath the signal can be received efficiently. So the performance of channel estimation improves when Q increases, as all channel taps are set to have unit variance.

6. Conclusion

We have applied the convolution codes and equalization for the error free transmission. The superimposed training and pilot sequences are applied on the two way MIMO relay system in frequency selective fading environment. For using the multipath the NMSE is minimized. The power allocation between the source and destination is optimized. Then the simulation results shows the better performance from the existing system.

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Author Profile

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