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High Frequency Channel State Estimation Using Hybrid Minimum Mean Squared Error- Zero Forcing Equalizer and Fourier Transform for MIMO –OFDM –NOMA system

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Abstract

Presently wireless network have been model for power and data communication simultaneously facing lot of challenges in resource allocation to frequency channels of different devices. In order to overcome the shortcomings, hybrid minimum mean squared error and zero forcing equalizer is used to enable massive data communication has been proposed in this paper. Initially different devices are exploited on correlation of channel frequency response across orthogonal frequency division multiplexing subcarriers on transmitter to model a high frequency linear channel model. Specifically MIMO –OFDM-NAMO subcarriers are divided into multiple sub-blocks and Fourier transform is used to approximate the frequency channels in each sub-block to obtain channel state information. It reduces Minimum mean squared error in the sub blocks. Further high frequency channel is estimated in the block using iterative algorithm. MATLAB software tool is employed for simulation and the performance analysis in terms of signal strength, error rate, transmission rate and CFO rate throughput has been evaluated and validated against the various existing schemes such as MIMO-OFDM.

Keywords: Multiple Input Multiple Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), Non Orthogonal Multiple Access (NOMA), Iterative Algorithm, Minimum Mean Squared Error (MMSE), Zero Fading (ZF)

1. Introduction

Wireless Network is been evolving with more advancement in channel management for both power and data communication simultaneously for smart city scenarios with increased connectivity and spectral efficiency for advanced connectivity. MIMO-OFDM is technology for modern wireless communication including long term evolution (LTE) and 5G with high energy efficiency on compared to single input single output system [1]. During propagation, changes in amplitude and phase of radio wave occurs which results in deterioration in system performance on QOS parameters on the receiver side[2].

In order to eliminate those complications, channel estimation technique is employed. Mostly fading channel occurs due to multiple path propagation on transmitter and it further leads to inter symbol interference (ISI) in receiver. Channel estimation is measure of the sequence of different bits of specific and repeated transmission. OFDM[3] is a modulation technique employed to MIMO models towards efficient bandwidth utilization with high throughput data communication[4]. Further to enable massive data communication, equalizer has to be employed efficiently in the transmitter to eliminate the multipath fading due to radio frequency impairment.

Hybrid minimum mean squared error and zero forcing equalizer is used to enable massive data communication has been proposed in this paper. Initially different devices are exploited on correlation of channel frequency response across orthogonal frequency division multiplexing subcarriers on transmitter to model a high frequency linear channel model. Specifically MIMO –OFDM-NAMO subcarriers are divided into multiple sub-blocks and Fourier transform is used to approximate the frequency channels in each sub-block to obtain channel state information. It reduces Minimum mean squared error in the sub blocks. Further high frequency channel is estimated in the block using iterative algorithm

Rest of the paper is organized into following section such that section 2 details the channel estimation for MIMO-OFDM system with or without NOMA. Section 3 provided detailed architecture of the proposed High Frequency channel state estimation using Hybrid Minimum mean squared error- Zero forcing Equalizer and Fourier transform for MIMO –OFDM –NOMA system. Experimental results of model are simulated using MATLAB Software and its performance evaluation has been described in section 4. Finally section 5 concludes the work

2. Related works

In this section, channel estimation in MIMO-OFDM model has been analysed on channel fading conditions has been represented as existing and related model to the proposed architecture

2.1. Massive data communication Over MIMO-OFDM: Channel Estimation With Frequency Selectivity Equalization

In this architecture, Joint activity detection has been utilized to estimate the channels in a multiple-input multiple-output orthogonal frequency-division multiplexing to enable massive data communication. Linear function is used with mean and slope to equalize the frequency of the channel to eliminate the Rayleigh fading due to radio-waves impairment[5].

2.2. Channel Estimation for One-Bit Massive MIMO Systems

In this architecture, channel estimation for massive multiple-input multiple-output (MIMO) systems using one-bit analog-to-digital converters (ADCs) with antenna-varying thresholds at the receivers has been considered. The channel matrix estimator is employed to maximize the one-bit likelihood function iteratively by solving simple linear least squares. Angular-domain channel model is considered to enhance the channel estimation performance using RELAX[6].

3. Proposed model

In this section, architecture of the proposed High Frequency channel state estimation using Hybrid Minimum mean squared error- Zero forcing Equalizer and Fourier transform for MIMO –OFDM –NOMA system has been modelled.

3.1. MIMO

Multiple Input Multiple Output is an antenna technology used to multiple input data transmission and multiple output reception through multiple paths in radio communication. It is Transmission is performed using orthogonal frequency division multiplexing with subcarrier. During multipath data propagation, radio waves change the amplitude and phase which results in channel fading[7].

3.2. Channel Estimation

Channel estimation is measure of the sequence of different bits of specific and repeated transmission. OFDM is a modulation technique employed to MIMO models towards efficient bandwidth utilization with high throughput data communication. Further to enable massive data communication, equalizer has to be employed efficiently in the transmitter to eliminate the multipath fading due to radio frequency impairment. Hybrid minimum mean squared error and zero forcing equalizer is used to enable massive data communication.

Initially different devices are exploited on correlation of channel frequency response across orthogonal frequency division multiplexing subcarriers on transmitter to model a high frequency linear channel model. Specifically MIMO –OFDM-NOMA subcarriers are divided into multiple sub-blocks and Fourier transform is used to approximate the frequency channels in each sub-block to obtain channel state information. Parameter such as signal to Noise ratio, power factor is computed on sub- carrier of the channel. MIMO –OFDM –NOMA has been used as it minimizes inferences on each subcarrier.

Signal to Noise Ration of the Sub carrier SNR = $\frac{P}{N_o}$

Where P is the transmitted power and N_o is the noise in channel.

It reduces Minimum mean squared error in the sub blocks. Further high frequency channel is estimated in the block using iterative algorithm. The phase changes are estimated with respect to time and it is represented using SNR variation.

Signal Transmitted in the channel is $Tx=(a*b*\sqrt{\frac{3}{2}})*Signal$

Fading loss of the channel $P_{loss} = [norm\ (a,b)]^{PL\ factor}$

The transmitting signal minimizes the multiuser interferences on the subcarriers and to separate the superimposed signal, successive interference cancellation technique is employed using Hybrid Minimum mean squared error- Zero forcing Equalizer and Fourier transform. Fourier Transform is used to mitigate the interference in the channel. Figure 3.1 represents the proposed block diagram of the work.

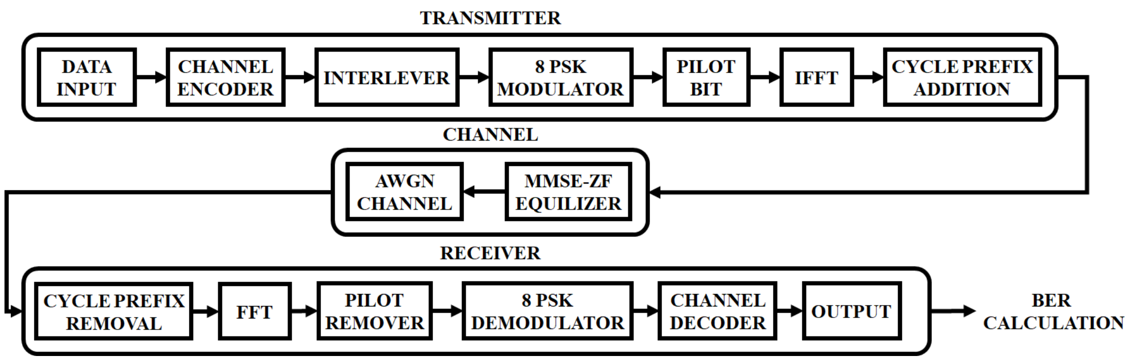

Figure 3.1: Proposed Block Diagram

Non Orthogonal multiple Access hybridization with orthogonal frequency division multiplexing gives optimal power efficiency. It is power control method as it strengthens the channel by cancelling the interference. The amplitude and optimal power of the communication channel is given by

Amplitude A = $\log_2(1+\frac{(g+P)}{(g+p+N_{o)}}$

Where N_o is the average Noise and signal g and power as p

Iterative Algorithm

It composed of the array and it assigns the amplitude [8]. The array is used to generate the complex valued spectrum. Fourier transform is used to estimate data distribution with imposing time domain constraints to it.. It further used to obtain optimal pilot phase shift scheduling condition applicable to both channel estimation and prediction. It is capable of jointly allocating subcarriers and powers to the communication paths.

Data distribution is selected and averaged using linear sampling to attain the channel without fading loses Power domain NOMA defines multiple user usage in the power domain and examines channel differences between multiplexed users with time synchronization with same frequency to the channel.

MMSE-ZF EQUALIZERS

It is to minimize the inter-symbol interference and additive noise effects, the equalizer coefficients can be optimized using the minimum mean squared error (MMSE) criterion. When the SNR has elevated values the MMSE equalizer works as Zero Forcing The zero forcing (ZF) and minimum mean squared error. (MMSE) equalizers applied to wireless multi-input multi-output (MIMO) systems with no fewer receive than transmit antennas[9].

4. Experimental results

In this part, experimental results of the proposed architecture are simulated and evaluated using MATLAB simulator[10]. Channel estimation of the MIMO-OFDM model with and without NOMA is computed on basis of channel fading. Further results have computed on subcarrier with elimination of the interference has been illustrated in the figure 3.2

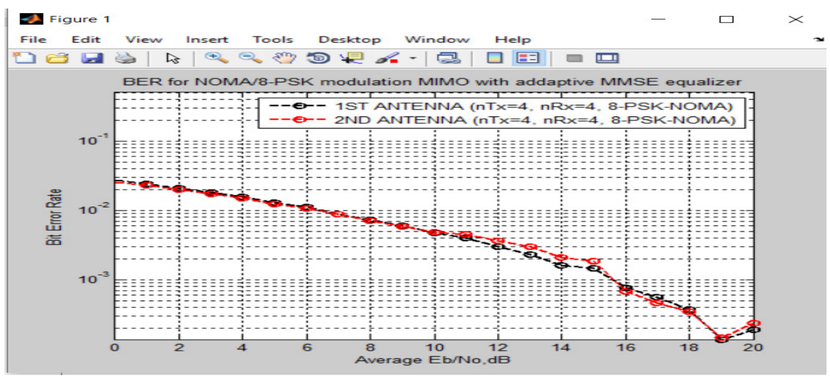

Figure 3.2: Bit error rate analysis of the MIMO-OFDM-NOMA model

Meanwhile hybrid minimum mean squared error and zero forcing equalizer is used to reduce the frequency changes and phase change in the data propagation Figure 3.3 represents the signal to noise ratio of the subcarrier using MIMO-OFDM

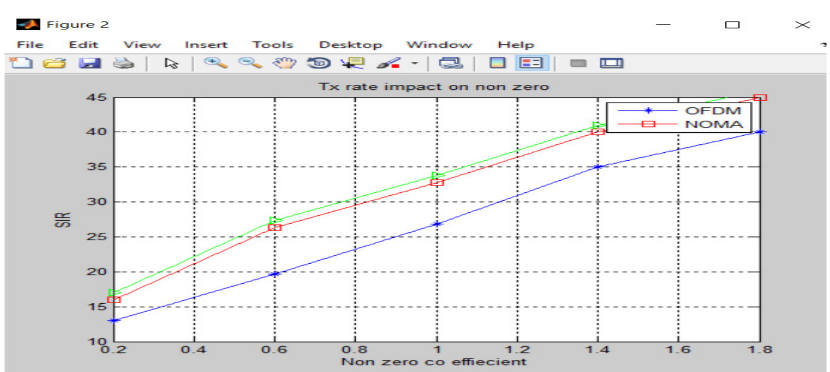

Figure 3.3: Signal to Noise Ratio

Inter-symbol interference and additive noise on the channel can be equalized using equalizer coefficients along with minimum mean squared error (MMSE) criterion and fast Fourier transform on MIMO-OFDM model. Figure 3.4 represents the throughput of the carrier frequency offset of the channel.

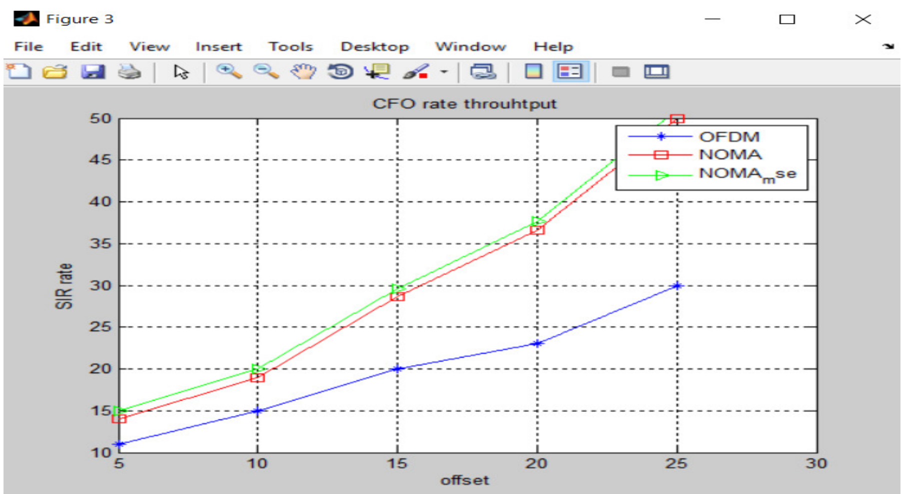

Figure 3.4: Data Throughput of the Carrier frequency in various models

The phase changes are estimated with respect to time and it is represented using SNR variation on the MIMO-OFDM model. Finally power control method as it strengthens the channel by cancelling the interference. The amplitude and optimal power of the communication channel is given in the figure 3.5

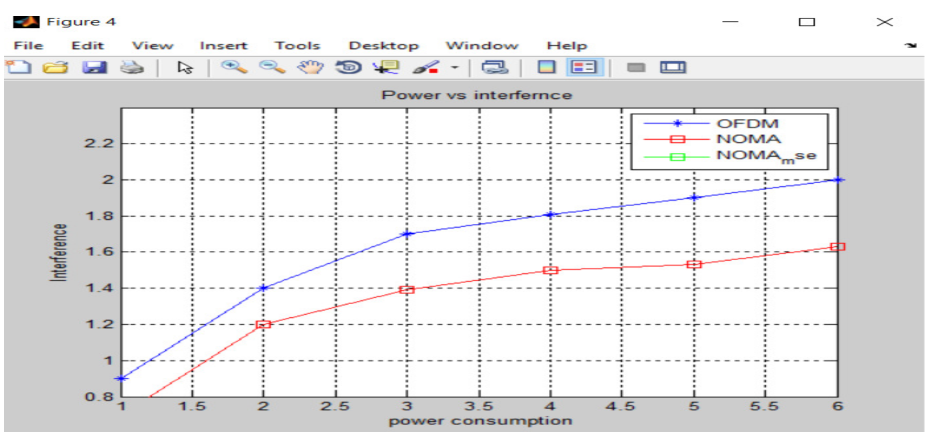

Figure 3.5: Power allocation towards interference cancellation

Proposed model for High Frequency channel state estimation using Hybrid Minimum mean squared error- Zero forcing Equalizer and Fourier transform for MIMO –OFDM –NOMA system has been employed to future communication wireless communication networks for data and power transfer.

Conclusion

We designed and simulated high frequency channel estimation technique for MIMO-OFDM –NOMA Model using hybrid minimum mean squared error and zero forcing equalizer to enable massive data communication. With estimated channel state information on correlation of channel frequency response at multiple sub-blocks provides approximation of the channel frequency in each block. . Simulations results are represented for estimated channel with NOMA and without NOMA on MIMO-ODDM model represents with NOMA higher number of signals can be transmitted at a time which. Performance results of the proposed model ensure enhanced power efficiency on analysis in terms of signal strength, error rate, transmission rate and CFO rate throughput against the various existing schemes such as MIMO-OFDM.

References

[1] D. Bertsekas, G. Lauer, N. Sandell, and T. Posbergh, "Optimal shortterm scheduling of large-scale power systems," IEEE Trans. Autom. Control, vol. AC-28, no. 1, pp. 1–11, Jan. 1983.

[2] A. M.-C. So and Y. J. Zhang, "Distributionally robust slow adaptive OFDMA with soft QoS via linear programming," IEEE J. Sel. Areas Commun., vol. 31, no. 5, pp. 947–958, May 2013.

[3] Y. Shen, X. Huang, K. S. Kwak, B. Yang, and S. Wang, "Subcarrierpairing-based resource optimization for OFDM wireless powered relay transmissions with time switching scheme," IEEE Trans. Signal Process., vol. 65, no. 5, pp. 1130–1145, Mar. 2017.

[4] H. H. Kha, H. D. Tuan, and H. H. Nguyen, "Joint optimization of source power allocation and cooperative beamforming for SC-FDMA multi-user multi-relay networks," IEEE Trans. Commun., vol. 61, no. 6, pp. 2248–2259, Jun. 2013.

[5] E. Che, H. D. Tuan, and H. H. Nguyen, "Joint optimization of cooperative beamforming and relay assignment in multi-user wireless relay networks," IEEE Trans. Wireless Commun., vol. 13, no. 10, pp. 5481–5495, Oct. 2014.

[6] D. W. K. Ng and R. Schober, "Cross-layer scheduling for OFDMA amplify-and-forward relay networks," IEEE Trans. Veh. Technol., vol. 59, no. 3, pp. 1443–1458, Mar. 2010.

[7] F. Alavi, K. Cumanan, Z. Ding, and A. Burr, "Robust beamforming techniques for non-orthogonal multiple access systems with bounded channel uncertainties," IEEE Commun. Lett., vol. 21, no. 9, pp. 2033–2036, Sep. 2017.

[8] Q. Zhang, Q. Li, and J. Qin, "Robust beamforming for nonorthogonal multiple-access systems in MISO channels," IEEE Trans. Veh. Technol.,vol. 65, no. 12, pp. 10231–10236, Dec. 2016.

[9] L. Lei, D. Yuan, C. K. Ho, and S. Sun, "Power and channel allocation for non-orthogonal multiple access in 5G systems: Tractability and computation," IEEE Trans. Wireless Commun., vol. 15, no. 12, pp. 8580–8594, Dec. 2016.

[10] P. D. Diamantoulakis, K. N. Pappi, Z. Ding, and G. K. Karagiannidis, "Wireless-powered communications with non-orthogonal multiple access," IEEE Trans. Wireless Commun., vol. 15, no. 12, pp. 8422–8436, Dec. 2016.

