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Performance Enhancement in MIMO-OFDMA System

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***Abstract**: The systematic advancement in wireless communication has provided many significant aspects towards communication domain. However, obtaining the high-speed data transmission is still a biggest concern in various multimedia-based applications. Multiple Input Multiple Output - Orthogonal Frequency Division Multiplexing Access (MIMO-OFDMA) based communication is widespread towards research area. In addition, the combination of MIMO-OFDMA with the steering antenna can lead to improved communication efficiency and offer diversity gain without changing radio frequency (RF). This paper introduces systems for power allocation and resource allocation by A) low complex compressive channel approximation (CSCE) and b) combined parallel cancelation and Viterbi encoding / decoding (PCVed). The outcome of compressive sensing based system brings reduced Bit Error Rate (BER) and less computational complexity while the performance analysis PCVed with different approaches for 4x4 transmitter and receiver.*

***Keywords**: Parallel Cancellation, BER, Complexity, Convolution Encoder*

I. INTRODUCTION

The increased use of smart devices in today's world has posed an interest in advancement in wireless communication with higher data rate and least power consumption [1]. However, achieving better throughput in terms of high data transmission is the biggest concern. A steerable antenna of three elements with MIMO-OFDMA can offer better directivity pattern even with low power consumption [2-4]. With the increased use of smart devices and applications, it very hard to achieved high data transmission [5]. Even though the existing OFDM techniques have multipath channels offering broad bandwidth resulting OFDM architecture acquires some propagation delays [6-7]. Also, these architectures may carry some sparse data were the conventional approaches were failed to compute sparse data [8]. Hence, this paper focuses on channel estimation, which favors the multipath path channels and reduces BER.

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Also, a MIMO-OFDMA system having a combination of both PCVed is aimed to design for 4x4 transmitter (TX) and receiver (Rx) by considering BER and Signal to Noise Ratio (SNR) as performance parameter. The organization of this paper is performed as review of literature (in section II) discussing existing researches in MIMO-OFDMA for BER minimization and performance enhancement in terms of BER and SNR, description of problem (in Section III) considered, Proposed models (in section IV) involving both the designs of channel estimator and PCVed based system that includes algorithm and flow chart, Performance analysis (in Section V) of both the systems and Conclusion (in Section VI).

II. REVIEW OF LITERATURE

The previous paragraph addresses contributory research involving reducing BER, allocating resources and consuming power. The survey in MIMO-OFDMA system has been discussed in Archana and Sureka [9] with a conceptualized discussion about MIMO and OFDMA. As discussed above the OFDM systems faces a problem with inter-cell interference and to mitigate those issues Perez et al. [10] have given a self-organizing algorithm, and with that, the system performance of OFDM is enhanced. Alsohaily et al. [11] also examined multi-radio communication device accesses. Huang et al. [12] uses Nash equilibrium to present the protocol-based algorithm to distribute the asset to smart devices.
Further, the optimal algorithm to achieve a quality of service in the OFDM system is found in Xiao et al. [13], but it does not involved with any comparative analysis. Addressing the high PAPR issue in an OFDM system, Ait-Saadi et al. [14] presented a self-adaptive algorithm, and it brings a low-cost system for PAPR optimization. Cao et al. [15] provided a scheduling framework to balance complexity and resource allocation. Feng et al. [16] have focused on energy efficiency in wireless communication along with MIMO, OFDM, etc. Similarly, Yin and Alamouti [17] expressed the OFDMA systems designs and compared with significance with traditional techniques. Boddu and Kamili [18] considered problem of inter-cell interference and resolved by selecting correct design parameters. Considering both resource allocation and power consumption, Mao et al. [19] given MIMO-OFDMA optimization technique which contains user selection, subspace selection of receive signal and efficient power allocation. Taking into account the problems of distributed resource allocation in MIMO Zappone et al. [20], the Dinkelbach algorithm has been implemented to achieve better power efficiency. Similar kind of works is observed in Feminias, and Riera-Palou [21] with channel aware and queue aware scheduling, and resource allocation mechanisms are provided. Moretti et al. [22]

proposed a layered MIMO-OFDMA system architecture in which users were divided into specific channel performance and assignment-based groups in order to achieve high QoS. For trade-off in energy & spectral efficiency improvement, Tang et al. [23] considered the number of users and active transmitted antennas for examination and presented energy efficiency optimization algorithm. The recent work of Archana and Sureka [24] discussed a channel estimator to minimize the rate of BER in MIMO-OFDMA. On analyzing the outcomes [24] come up with low-cost MIMO-OFDMA system. The work of Signal and Kedia [25] performed the analysis of MIMO-OFDMA system for energy perspective by considering per-subcarrier and bulk selection technique with hardware architecture.

The above discussed current works are more relevant to the proposed study as they aim to provide stable, power, and resource efficient MIMO-OFDMA to achieve better communication. There are many aspects in the existing researches which have motivated to proceed with the proposed study. The following section describes the problem considered in this paper.

III. PROBLEM DESCRIPTION

The OFDM is considered an efficient modulation scheme, but it consists of interferences at carriers. In order to resolve these issues, the cyclic prefix has been incorporated in existing techniques, but it poses data redundancy. Thus, to transfer redundant data, the system needs more bandwidth and power. However, to remove the redundancy in the data, parallel cancellation mechanisms were considered. Using parallel cancelation technique, this redundancy of data can be eliminated. However, the use of parallel cancellation with a wide bandwidth in real-time multi-path channels can lead to the sparse OFDM system; hence, the multipath communications leads propagation delays. The existing methods generate a zero impulse response under a noisy condition which indicates the sparse architecture of multipath channel. Thus, no conventional technique does sparse data estimation in which sparse signal was ignored to reduce the BER of received data. When reviewing various existing research, it was found that these research was lagging with the issue of accuracy in channel estimation and difficulty in computation due to the inverse matrix calculation. Thus, the problem statement is that *"there is a need for low complex channel estimation system and efficient MIMO-OFDMA system is required that can offer resource allocation and power consumption*." The following section presents the design perspective of proposed models for channel estimation achieve performance enhancement in MIMO-OFDMA.

IV. PROPOSED MODELS

This section provides the design and implementation of both the models given for performance enhancement in MIMO-OFDMA system.

A. Compressive Sensing based Channel Estimator (CSCE)

This model is designed by aiming minimization of computational complexity and BER by introducing compressing sensing based channel estimator in MIMO-OFDMA system. The assumptions have been considered from prior work [24] and extended further. For the design of this model, Tx and Rx are used with the pilot frequency of 4 and energy of 1. The architectural model of the channel estimator is given in Figure.1. The CSCE model considers the image as input data on which the image modulation technique is applied to balance the resolution as well as the contrast of the image. Once the modulation is performed, the modulated image is subjected to the OFDMA modulation, which splits the image signals into channels by adapting cyclic prefix and IFFT operation in the modulation. This OFDMA modulation reduces the crosstalk (is a disturbance caused due to electromagnetic signals) in wireless communication which lowers the noise or errors in the transmitted signal. Later, the inputs SNR is used for channel condition adaption. Similarly, by using the cyclic prefix and FFT process, OFDMA demodulation is used at Rx end for channel noise elimination.

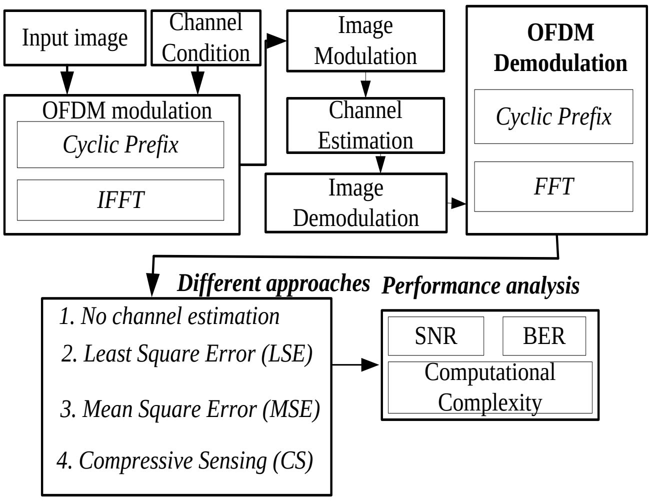

Fig. 1.Architectural Model of CSCE

Then, channel estimation is done under no channel estimation (NCE), Least Square Error (LSE), Minimum Mean Square Error (MMSE) and compressive sensing channel estimator (CSCE) methods. To remove the original information from the carrier wave, demodulation is applied. The data is then obtained using various methods of channel estimation and analyzed for performance.

Because of smaller size, a three-element steering antenna is used in CSCE model and it consumes low power. Variable capacitors terminate the steering antenna consisting radiator component is given to RF front end and also consists of single or multiple active or parasitic components. The antenna's beam path is controlled by using the difference in the capacitors bias voltage. Both parasitic elements and elements of the radiator are divided by the distance $0.1 \times \lambda$ from which the wavelength (λ) is measured.

Figure.2 defines the steering antenna based on three components with a frequent change of direction. The antenna consists of one capacitor and two parasite components as a bias voltage with sinusoidal waves. The sinusoidal amplitude is equal to the spacing of the OFDM subcarrier frequency. The impact of directivity effect is a signal frequency modulation accepted by the parasitic elements.

The study carried out in the frequency domain, where all three components were applied to the received signal. A revised MIMO-OFDMA RX system is adapted with the periodic shift along with 3-elements-based steering antennas (ESA) consisting received signal's electronic elements. Within the frequency fading selective stream, the mechanism achieves the diversity gain and obtains improved BER. The unit design suggested consists of two Rxs and two Txs where the Tx is based on the IEEE 802.11n wireless LAN protocol.

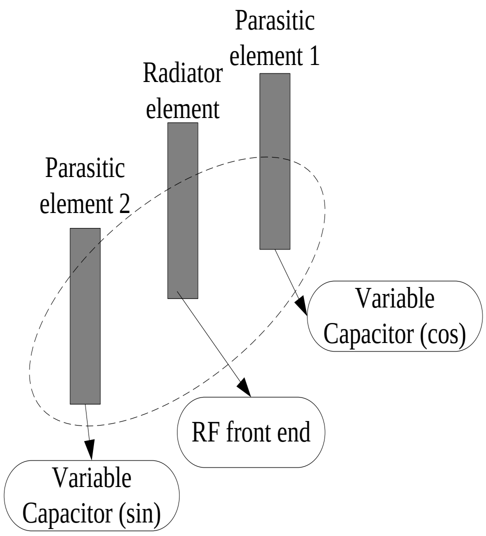

Fig. 2.3-steering antenna

B. PCVed Model

Together with other solutions such as MIMO-OFDMA system without parallel cancellation (XPC) and MIMO-OFDMA system with parallel cancellation (WPC) for 4x4 Tx and Rx, the development of MIMO-OFDMA system with PCVed is addressed for performance analysis. The proposed model's device development is carried out under a high BER noisy environment. The MIMO works on Optimal Binary Search Tree scheme (OBST) basis. The Tx end OFDMA uses IFFT system while Rx end OFDMA takes FFT operation into account. Also, the inter-carrier interference (ICI) is done by processing Tx information through IFFT service. The IFFT and FFT's parallel operation replaced the Tx information at the end of the Tx by using the Rx side's FFT operation and IFFT operation. The combination of FFT and IFFT at the end of the Tx and Rx helps to achieve the zero BER at 5 dB in the current MIMO-OFDMA configuration and 0 BER at new (-5dB) MIMO-OFDMA model. The PCVed model includes forward error correction (FEC) and detection methods such as Convolution encoding and Viterbi decoding, respectively, and is used before transmitted data modulation and after data received demodulation. These FEC mechanisms provide an additional data security layer in terms of error detection and correction through an increase of 1dB in received data. In addition to augmenting OFDM systems, some observations on OBST-OFDMA are evaluated using the 4x4 OBST-OFDM codeword matrixes with a coding frequency of 1. During the transmission range, the dynamic transmission of this orthogonally cannot be accomplished at the code frequency of 1 exceeds 2. Some of the current techniques proposed models for non-orthogonal complex transmission with a coding frequency of 1 and having the same order of complexity as maximum transmitting antennas.

The 4x4OBST-OFDM device is therefore used with a non-orthogonal transmission matrix, 1 coding frequency, and 4 transmission diversity. Alternatively, a code frequency of 0.5 is evaluated for the orthogonal transmission matrix template. Figure.3 reflects the MIMO-OFDMA system's structural design with PCVed. The PCVed model takes image input into consideration and converts to binary format. Pre-processing operations are subjected to the same binary data to generate good output signal value. Then, the encoding is used for input signal convolution and through QPSK modulation based on the Tx number used. The OFDM modulation through parallel cancelation is performed at the Tx end. The signal is then transformed to a frequency domain.

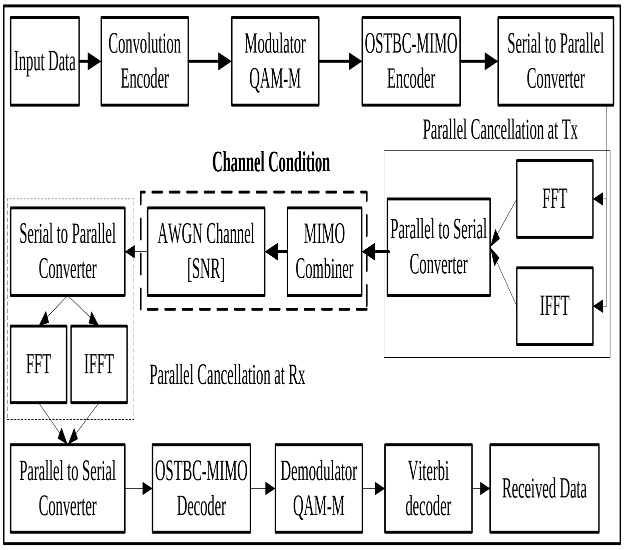

Fig. 3. Architecture of MIMO-OFDMA with PCVed

The contact channel transmits these signals. Together with AWGN sound, the channel provides the MIMO channel. Using signal range, this SNR is adjusted. It is then distributed. The demodulation of the received signal is carried out in accordance with the parallel method of cancellation via the OFDM demodulation scheme and the demodulated signal is subjected to OSTBC based on Rx devices used. Then, QPSK demodulation approach is used for signal demodulation, decoding scheme for Viterbi to eliminate all the received signal noise. The obtained data will be translated at Rx end in original form. Three different approaches compare the BER like MIMO-OFDMA system having PCVed, without parallel cancellation and with parallel cancellation for 4x4 Tx and Rx.

C. Flow Model of CSCE

Figure.4 shows the entire flow diagram. The CSCE model's transmission end considers an input image (In), resized to 0.1 formats and is stored as an image rescaled (Io). The rescaled image is then transformed matrix of $Nr \times Nc$ (8bit integer) where Nr and Nc is a number of rows and number of columns respectively. The modulation is applied to change the image's resolution and contrast. The modulated image (Im) is also translated to the 8bit image binary in decimal format. In addition to applying the OFDMA modulation to Im, adding cyclic prefix (CP) and inverse FFT.

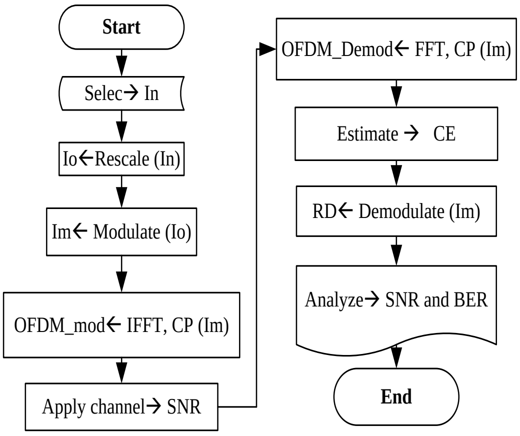

Fig.4. Flow Model of CSCE

The signals are then divided into channels. In addition, the input SNR is provided to use the data transmission channel via wireless communication. The OFMA demodulation, which includes CP removal and FFT operation at the Rx end.

D. Algorithm for PCVed Model

The algorithm is initialized with the sampling rate of (λ), path delay (δ), average path gain (τ), maximum Doppler shift (η) is performed. The disk image is resized with a factor of 0.1 and the trellis structure (t) of the stored binary form is generated to use for convolution encoder that gives all the possible inputs to the encoder meant with the encoder transition states with binary form 00, 01, 10 and 11 which gives 2-bit,1-bit information. In addition, both the data factors and t are added to the convolution encoder, which provides a compressed data (Cd). To produce the modulated signal, QPSK scheme is applied for the signal. The encoding is performed by OSTBC which encodes the input symbol sequence. The OSTBC with MIMO, offers high SNR and low BER. The QPSK demodulation technique used to demodulate the signal. The SNR values are measured for the same signal and by considering the original data, the SNR value, the range of transmission and the range of Rxs. Finally, converting / reforming the obtained signal into the original format. This section allows the algorithm to be implemented to achieve increased resource allocation and minimize power consumption.

Algorithm: to enhance resource allocation and minimize power consumption

Input: I, I_1, Cd, Qmd, α, β, SNRr, λ,δ τ, η, φ, ς, Φ
Output: Reduced BER
Start

1. **Initialize** λ =1e6, δ= [0 2e-6], τ = [0 -10], η =30.
2. resize (I_{org}, 0.1)←I_{org}← read (I)
3. data←I_1 ← binary (I_{org})
4. t← trellis structure(I_1)
5. Cd ←Conv_encode (data, t)
6. Qmd←QPSK_Mod (bits, symbol, value)
7. modData←step (Qmd, data, Cd)
8. [E_{data}, n_2] ←OSTBC_encoder (Qmd, modData, β (1))
9. [E_{Cd} ,N_1,n_2]←ofdm_mod(E_{data});
10. Channel←MIMOChannel(λ, δ, τ, η, ς, β, α, φ);
11. Qmd_{AWGN}←$AWGN_{Channel}$(Noise, SNRr, Φ,1)
12. [α, G_p]←Ofdm_demod(α $_{Cd,}$ num α,n_2 , φ $_{Cd}$);
13. C_{data}←OSTBC $_{Combining}$(α $_{Signal,}$ $α_{signal\ Cd,}$ numβ, numα, φ,$n_{2\ Cd}$);
14. Qmd_{demod}←$QPSK_{demodv}$(Symbol, bits)
15. R_{data}← B_{i2}(R_{data})
16. **If** (SNRr>1)
    SNR← [2: end];
    else
    SNR← [];
17. **If** (α>1)
    SNR← [1: end];
    else
    SNR← [];
18. **If** (SNRr>1 && β >1 && α >1)
Apply MIMO_OFDM (SNR, β, α, Iorg)
    else
    NOP
19. **end if;**
20. R_{data}← Apply Viterbi(R_{Cd}, t, t_b,'trunc','hard');
21. Reshape bits → original data format

End

V. PERFORMANCE ANALYSIS

The performance analysis of the CSCE is analyzed with channel estimation using different approaches. Figure.5 shows SNR vs. BER's performance evaluation against different approaches. The SNR is the unnecessary voltage levels which entered into the signal being transmitted through the medium. The BER is the rate at which the error is produced due to the transmitted message interpretation. The inverse relationship between SNR and BER increases, i.e. BER increases with decrease in SNR and vice versa. The SNR is the direct measurement of the relative noise energy. From Figure.5, it was found that CSCE has 0dB BER at SNR 30 indicating the reduced BER and providing optimized computational complexity for high image quality at the Rx end.

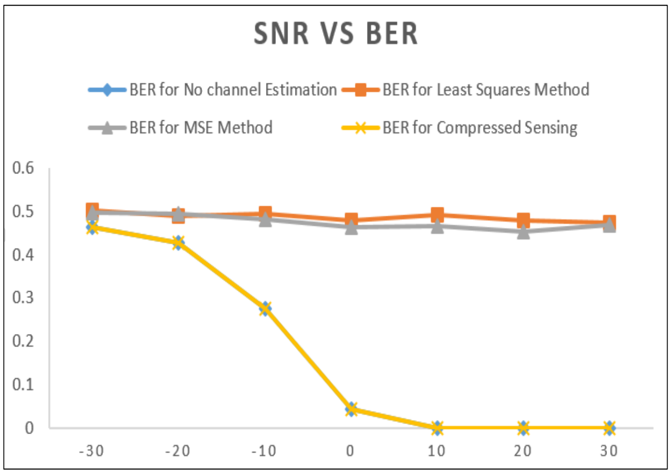

Fig.5. Performance Analysis of CSCE Model

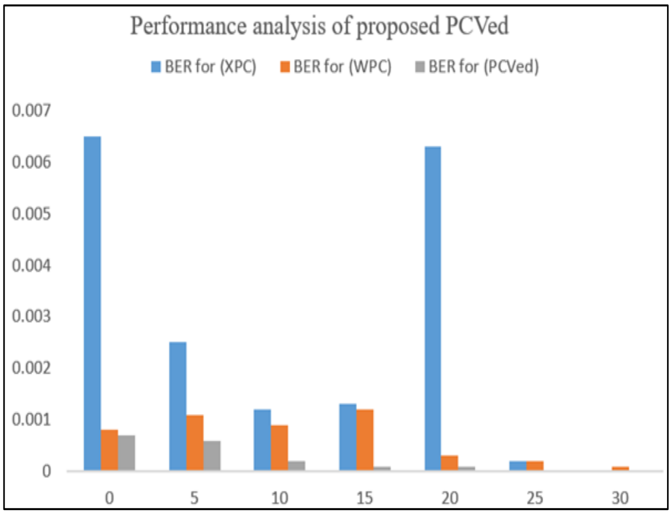

Fig.6. Performance Analysis of MIMO-OFDMA Having (PCVed)

Figure 6 shows the plot of various approaches like MIMO-OFDMA system XPC, MIMO-OFDMA system WPC and proposed MIMO-OFDMA system with PCVed for 4x4 Tx and Rx. With the decrease in SNR value, the BER increases. The high-value SNR means that the signal has more unwanted noise while the lower BER value shows the least error that occurred during the transmission of the signal. The comparison of all these approaches suggests that the MIMO-OFDMA system XPC exhibits more BER than other approaches with MIMO-OFDMA System WPC and PCVed proposed. Compared to the MIMO-OFDMA WPC and current MIMO-OFDMA having PCVed the proposed system has the lowest rate of error compared to another solution. It can therefore be said that the proposed MIMO-OFDMA with PCVed i.e., power and resource allocation (bandwidth) is accomplished by decreasing the BER frequency at high data level and also by increasing the power consumption at least BER.

VI. CONCLUSION

This paper aimed for enhancement of MIMO-OFDMA system performance by introducing CSCE and a combined technique involving PCVed system of 4x4 Tx and Rx. The contribution of this manuscript is that:

- The prior work [24] is considered and is extended to reduce BER and computational complexity while the PCVed system for MIMO-OFDMA system is introduced to achieve better resource allocation and power consumption. For performance analysis of MIMO-OFDMA system of CSCE is analyzed by comparing the channel estimation using no channel estimation (NCE), LSE and minimum MSE and is observed that proposed compressive sensing channel estimator (CSCE) has got 0dB BER at SNR of 30 which indicates the reduced BER and provides high quality of image at Rx end with optimized computational complexity than other methods.
- The performance analysis of MIMO-OFDMA system with PCVed is performed by comparing with other approaches like (XPC) and WPC for 4x4 under noisy conditions. During the analysis, it was found that MIMO-OFDMA with PCVed i.e., power and resource allocation (bandwidth) is achieved by minimizing the BER rate at high data rate and also by reducing the power consumption at least BER.

Further, the proposed models can be considered for future research to improve the performance by considering other parameters like throughput, security, and as per application requirements.

REFERENCES

1. Checko, Aleksandra, et al. "Cloud RAN for mobile networks—A technology overview." IEEE Communications surveys & tutorials 17.1 (2015): 405-426.
2. Khalifa, Tarek, KshirasagarNaik, and Amiya Nayak. "A survey of communication protocols for automatic meter reading applications." IEEE Communications Surveys & Tutorials 13.2 (2011): 168-182.
3. Feng, Daquan, et al. "A survey of energy-efficient wireless communications." IEEE Communications Surveys & Tutorials15.1 (2013): 167-178.
4. Harjula, Ilkka, et al. "Practical issues in the combining of MIMO techniques and RoF in OFDM/A systems." Proceedings of the 7th WSEAS International Conference on Electronics, Hardware, Wireless, and Optical Conference. 2008.
5. Nosratinia, Aria, Todd E. Hunter, and AhmadrezaHedayat. "Cooperative communication in wireless networks." IEEE Communications Magazine 42.10 (2004): 74-80.
6. Olwal, Thomas O., Karim Djouani, and Anish M. Kurien. "A survey of resource management toward 5G radio access networks." IEEE Communications Surveys & Tutorials 18.3 (2016): 1656-1686.
7. Akyildiz, Ian F., Dario Pompili, and Tommaso Melodia. "State-of-the-art in protocol research for underwater acoustic sensor networks." Proceedings of the 1st ACM international workshop on Underwater networks. ACM, 2006.
8. Gkelias, Athanasios, and Kin K. Leung. "Multiple antenna techniques for wireless mesh networks." Wireless Mesh Networks. Springer, Boston, MA, 2008. 277-307.
9. Archana B and T.P. Surekha, "Resource Allocation in LTE: An Extensive Review on Methods, Challenges, and Future Scope," Communications on Applied Electronics (CAE) – ISSN: 2394-4714 Foundation of Computer Science FCS, New York, USA Volume 3– No.2, October 2015.
10. Lopez-Perez, D, Chu, X., Vasilakos, A.V., Claussen, H.2014. Power Minimization Based Resource Allocation for Interference Mitigation in OFDMA Femtocell Networks. Selected Areas in Communications, IEEE Journal, vol.32, no.2, pp.333-344
11. Alsohaily, A.; Sousa, E.S.2015. On the Utilization of Multi-Mode User Equipment in Multi-Radio Access Technology Cellular Communication Systems. Access, IEEE, vol.3, pp.787-792.

12. Huang, J.; Yin, Y.; Zhao, Y.; Duan, Q.; Wang, W.; Yu, S.2014.A Game-Theoretic Resource Allocation Approach for IntercellDevice-to-Device Communications in Cellular Networks," Emerging Topics in Computing, IEEE Transactions, vol.PP, no.99, pp.1-1
13. Xiao, X; Tao, X; Lu, J.2015. Energy-Efficient Resource Allocation in LTE-Based MIMO-OFDMA Systems with User Rate Constraints. Vehicular Technology, IEEE Transactions on, vol.64, no.1, pp.185-197.
14. Ait-Saadi, Hocine, Jean-Yves Chouinard, and AbderrazakGuessoum. "A PAPR Reduction for OFDM Signals Based on Self-Adaptive Multipopulation DE algorithm." International Journal of Electrical and Computer Engineering (IJECE) 7.5 (2017): 2651-2660.
15. H. Cao, J. Cai, A. Alfa, and Z. Zhao, "Efficient resource allocation scheduling for MIMO-OFDMA-CR downlink systems," 2016 8th International Conference on Wireless Communications & Signal Processing (WCSP), Yangzhou, 2016, pp. 1-5.
16. D. Feng, C. Jiang, G. Lim, L. J. Cimini, G. Feng, and G. Y. Li, "A survey of energy-efficient wireless communications," in *IEEE Communications Surveys & Tutorials*, vol. 15, no. 1, pp. 167-178, First Quarter, 2013.
17. Maeder, Andreas, and Nader Zein. "OFDMA in the field: current and future challenges." *ACM SIGCOMM Computer Communication Review* 40.5 (2010): 71-76.
18. S. Boddu and J. B. Kamili, "Analysis of design parameter issues for next generation OFDMA downlinks," *2017 Progress in Electromagnetics Research Symposium - Fall (PIERS - FALL)*, Singapore, 2017, pp. 2707-2717.
19. J. Mao, C. Chen, X. Cheng, and H. Xiang, "Energy efficiency optimization in MIMO-OFDMA systems with block diagonalization," in *IET Communications*, vol. 11, no. 18, pp. 2681-2690, 12 21 2017.
20. Zappone, E. Jorswieck and A. Leshem, "Distributed Resource Allocation for Energy Efficiency in MIMO OFDMA Wireless Networks," in IEEE Journal on Selected Areas in Communications, vol. 34, no. 12, pp. 3451-3465, Dec. 2016.
21. G. Femenias and F. Riera-Palou, "Scheduling and Resource Allocation in Downlink Multiuser MIMO-OFDMA Systems," in *IEEE Transactions on Communications*, vol. 64, no. 5, pp. 2019-2034, May 2016.
22. Moretti, Marco, Luca Sanguinetti, and Xiaodong Wang. "Resource allocation for power minimization in the downlink of THP-based spatial multiplexing MIMO-OFDMA systems." *IEEE Transactions on Vehicular Technology* 64.1 (2015): 405-411.
23. J. Tang, D. K. C. So, E. Alsusa, K. A. Hamdi and A. Shojaeifard, "On the Energy Efficiency-Spectral Efficiency Tradeoff in MIMO-OFDMA Broadcast Channels," in *IEEE Transactions on Vehicular Technology*, vol. 65, no. 7, pp. 5185-5199, July 2016.
24. Archana, B., and T. P. Surekha. "A Compressive Sensing Based Channel Estimator and Detection System for MIMO-OFDMA System." In Proceedings of the Computational Methods in Systems and Software, pp. 22-31. Springer, Cham, 2018.
25. Singal, Anuj, and Deepak Kedia. "Performance Analysis of Antenna Selection Techniques in MIMO-OFDM System with Hardware Impairments: Energy Efficiency Perspective." International Journal of Electrical and Computer Engineering (IJECE) 8.4 (2018)

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