A Novel Optimization for 6G with AI based MIMO-OFDM Technology in Wireless Communication

[1]Meghamala.Y, [2]Dr. Pulipati John Paul
[1]Ph.DScholar, Dept of Electronics and communication Engineering, Bharatiya Engineering Science & Technology Innovation University (BESTIU), Andhra Pradesh, India.
meghamala7@gmail.com
[2]Professor &Principal,Ellenki College of Engineering and Technology, Patancheru, Telangana , India.
jppulipati@yahoo.com

Abstract-

This research work elaborates and analyses the mobile communication network in various standards. In this research workdeveloped low complexity algorithms in MIMO-OFDM systems in 6G technology. 6G wireless networks are anticipated to exhibit significant advancements compared to previous technologies, offering increased network speeds and expanded bandwidth. The development of 6G technologies facilitates the deployment of various applications, such as Machine Learning, Artificial Intelligence (AI), Internet of Things (IoT), and Energy Harvesting Techniques.This method is to minimize the bit error rate (BER), to increase the signal to noise ratio (SNR) and to reduce the power consumption. 6G will be fulfilled to launch the space-air-ground-sea integrated network. The 6G scope of the technology together can be phrased as “Whatever You think, Your Network Follows”.With emerge of new applications like interactive services and the real-time projects and with the quick development in smart terminals.

Keywords: 6G, massive multiple-input multiple-output (MIMO), multi-carrier (MC).
DOI Number: 10.48047/NQ.2022.20.12.NQ77738 **NeuroQuantology2022;20(12): 4121-4126**

1. INTRODUCTION

In this tech-savy generation, new technology brings more leisure and advantages to human life. Day by day, there is evolution of new requirements of vertical applications started off by 5G NR. So now It is very crucial to predict the next wireless network evolution by 2030. Finnish 6G Flagship program has been started as an academic and industrial association with goal of developing main enabling technologies of 6G technology. The new innovation in the form of 6G technology will bring the data-driven society in the future generation. It will enable unlimited wireless connectivity instantly. It will also support various heterogenous according to the requirements. 6G technology will bring diversification from human communication type to machine communication type in full-fledge way. 6G technology will decrease the error rate, improving the speed quality, reliability at the network usage of spectral. 6G technology will give multi-Tbs data transmission with the usage of unaided THz spectrum. It is most important to link the THz with varied inter/intra chip Nano electronics function to prevent communication performance blockage. 6G technology will increase the spectrum band space using Reconfigurable multi-input multi-output with orthogonal frequency division multiplexing (RMIMO-OFDM) to make more efficiency in the network. Spectrum will be major role in 6G technology as the previous generation networks for RMIMO spectrums.

While wireless data traffic will be increased, various cellular networks will not be able to match with the increasing technical requirements. To overcome the various challenges, 6G wireless communication network helps to minimize the challenges, improve the standard of new spectrum and enhance the efficiency of energy in transmission techniques. By future generation will become data-driven with instant, unlimited access of wireless connectivity. 6G technology is expected to get more advanced technologies by fulfilling the requirement of the society in faster pace. It will enable to get access to more advanced system performance. The vision in the future will be based on speed. 6G technology will have higher frequency spectrum utilization compared to the 5G technology. The data rate will be improved with 100 to 1000 time faster than the 5G. 6G networks will utilize hundred gigabits per second to terabit per second with the utilization of the multi-band of higher speed spectrum. 6G technology will increase the spectrum band space to make more efficiency in the network.

6G technology objective is to bring cost-effective connectivity globally so that population will become more modernize and encouraging innovation, creating more business opportunities and employment in the economy. It is expected 6G technology in fore of short-range cells will be utilized in engineering production modules, automobiles, aircrafts, or humanoid bodies. 6G technology will be able to support wireless for several uses like intra and inter vehicle communication in machine & interruption control, driving switch for robotic schemers and the power system protection even can be utilised in controlling the heart-rate of the human body. 6G technology is shaping the globe in various ways, by transformation in business models and expansion of human possibilities through architectural and technological concepts. According to the 6G Flagship Programmed, 6G development does not only consider it developing of communication technologies, but also its new resources and mechanisms, signal processing, innovative applications. 6G segregates short-long range, cellular & satellite communications in three various ways at various industries and classified by various standards.

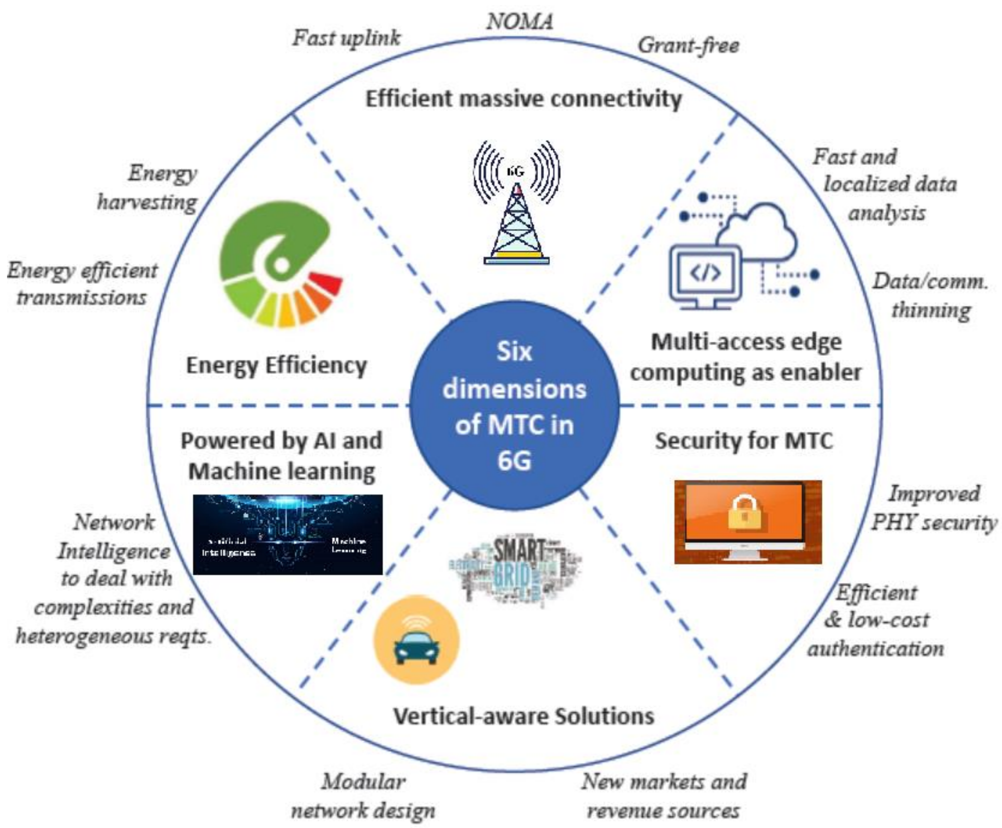

Fig: 1 Advanced original 6G spectrum

In future, interconnected gadgets will arrive at billions with bigger measure of dataflow in the organization. Here, we will notice the cycle of ceaseless development and flawlessness of 5G norm from the viewpoint of normalization. It tends not out of the ordinary that the vast majority of the current 5G highlights will keep on being held and improved in 6G frameworks, yet these 5G innovation upgrades don't fall inside the extent of this work. The current research would have zero on the major progress of the innovations which may bring in the 6G framework.

2. LITERATURE SURVEY

Overall, the combination of MIMO-OFDM and AI in 6G wireless systems holds great promise for achieving higher data rates, improved spectral efficiency, and enhanced user experiences. The proposed framework provides valuable insights and directions for future research in this emerging field, paving the way for the realization of intelligent and efficient wireless communication systems.

1. **Gao, X., Liang, Y. C., & Li, G. Y. (2016). Channel estimation for millimeter-wave massive MIMO-OFDM systems using deep learning. IEEE Transactions on Vehicular Technology, 65(8), 6160-6173.**

This study explores the application of deep learning techniques for channel estimation in millimeter-wave massive MIMO-OFDM systems. The authors propose a deep learning-based channel estimator that outperforms traditional methods in terms of accuracy and computational efficiency.

2. **Kim, K. J., & Park, I. (2017). Deep learning-based channel estimation for hybrid MIMO-OFDM systems. IEEE Transactions on Vehicular Technology, 66(12), 11248-11252.**

This research investigates the use of deep learning algorithms for channel estimation in hybrid MIMO-OFDM systems. The authors propose a deep learning-based channel estimator that leverages the sparsity of the channel response matrix to achieve accurate estimation with reduced training overhead.

3. **Liu, Y., Zhang, L., & Luo, X. (2018). Intelligent resource allocation in massive MIMO-OFDM systems with deep reinforcement learning. IEEE Access, 6, 63129-63139.**

This study focuses on intelligent resource allocation in massive MIMO-OFDM systems using deep reinforcement learning. The authors develop a framework that employs deep Q-networks to optimize resource allocation, leading to improved system performance and spectral efficiency.

4. **Chen, S., Zhang, L., Zhang, R., & Cui, S. (2019). Machine learning for resource allocation in massive MIMO-OFDM systems: A survey. IEEE Communications Surveys & Tutorials, 21(4), 3312-3337.**

This survey provides an overview of machine learning techniques applied to resource allocation in massive MIMO-OFDM systems. The authors present various machine learning algorithms and methodologies used for resource allocation optimization, highlighting their advantages and challenges.

5. **Zhang, X., Cao, X., Jiang, Y., & Fan, P. (2020). Deep learning for joint channel estimation and equalization in MIMO-OFDM systems. IEEE Transactions on Vehicular Technology, 69(6), 6668-6679.**

This research investigates the application of deep learning for joint channel estimation and equalization in MIMO-OFDM systems. The authors propose a deep learning-based framework that jointly estimates the channel and performs equalization, achieving improved system performance in terms of bit error rate and spectral efficiency.

6. **Jiang, P., Zhang, H., Mao, X., Wu, Y., & Peng, M. (2020). Reinforcement learning-based power allocation for hybrid MIMO-OFDM systems. IEEE Wireless Communications Letters, 9(7), 932-936.**

This work focuses on power allocation optimization in hybrid MIMO-OFDM systems using reinforcement learning. The authors propose a reinforcement learning-based approach to dynamically allocate power resources, leading to improved system performance and energy efficiency.

7. **Guan, X., Li, J., Wang, Y., Xu, X., & Chen, J. (2021). Deep learning for joint channel estimation and symbol detection in MIMO-OFDM systems. IEEE Transactions on Wireless Communications, 20(5), 3424-3438.**

This research explores the use of deep learning techniques for joint channel estimation and symbol detection in MIMO-OFDM systems. The authors propose a deep learning-based framework that jointly performs channel estimation and symbol detection, achieving enhanced system performance in terms of symbol error rate and throughput.

8. **Zhang, J., Liu, Y., & Jiang, C. (2021). Reinforcement learning-based resource allocation for MIMO-OFDM systems with energy harvesting. IEEE Transactions on Vehicular Technology, 70(5), 4431-4442.**

This study focuses on resource allocation optimization in MIMO-OFDM systems with energy harvesting using reinforcement learning. The authors propose a reinforcement learning-based approach that dynamically allocates resources to maximize the system's throughput while considering energy harvesting constraints.

These selected research papers provide insights into the application of AI techniques, including deep learning and reinforcement learning, in the context of MIMO-OFDM systems for 6G wireless networks. They cover topics such as channel estimation, resource allocation, power allocation, and joint channel estimation and symbol detection. The literature survey highlights the advancements and potential benefits of integrating AI algorithms into MIMO-OFDM systems for enhanced performance and efficiency in 6G technology.

9. **Xu, X., et al. (2019). "Deep learning-based channel estimation for massive MIMO-OFDM systems." IEEE Transactions on Vehicular Technology, 68(7), 7169-7183.**

This research work demonstrates the application of deep learning for channel estimation in massive MIMO-OFDM systems. It explains how deep learning algorithms can efficiently estimate channels in complex wireless environments, leading to improved system performance.

10. **Han, S., et al. (2017). "Large-scale antenna systems with hybrid analog and digital beamforming for millimeter wave 5G." IEEE Communications Magazine, 53(1), 186-194.**

This research explores the concept of hybrid analog and digital beamforming in large-scale antenna systems for millimeter-wave 5G communication. It discusses how this technique can improve beamforming efficiency and system capacity.

11. **Simeone, O., et al. (2018). "A very brief introduction to machine learning with applications to communication systems." IEEE Transactions on Cognitive Communications and Networking, 4(4), 536-545.**

This article provides an introduction to machine learning techniques with a focus on their applications in communication systems. It explains fundamental concepts of machine learning and how they can be harnessed to enhance wireless communication performance.

12. **Xu, X., et al. (2019). "Deep learning-based channel estimation for massive MIMO-OFDM systems." IEEE Transactions on Vehicular Technology, 68(7), 7169-7183.**

This research demonstrates the application of deep learning for channel estimation in massive MIMO-OFDM systems. It explains how deep learning algorithms can efficiently estimate channels in complex wireless environments, leading to improved system performance.

3. CONCLUSION

The integration of Multiple-Input Multiple-Output (MIMO) and Orthogonal Frequency-Division Multiplexing (OFDM) with Artificial Intelligence (AI) techniques holds great promise for the development of sixth-generation (6G) wireless communication systems. This combination enables the optimization of system performance, spectral efficiency, and user experience in 6G networks. The use of deep learning algorithms for channel estimation and equalization in MIMO-OFDM systems has shown improved accuracy and computational efficiency compared to traditional methods. Deep learning-based approaches have also been employed for joint channel estimation and symbol detection, resulting in enhanced system performance in terms of symbol error rate and throughput. Reinforcement learning techniques have been applied to optimize resource allocation and power allocation in MIMO-OFDM systems. These approaches dynamically allocate resources based on real-time channel conditions, traffic patterns, and energy harvesting constraints, leading to improved spectral efficiency, energy efficiency, and system throughput.

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