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Retraction

Retracted: Application of 5G Mobile Communication Technology Integrating Robot Controller Communication Method in Communication Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Chen, "Application of 5G Mobile Communication Technology Integrating Robot Controller Communication Method in Communication Engineering," *Journal of Robotics*, vol. 2023, Article ID 1857590, 9 pages, 2023.

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Research Article

Application of 5G Mobile Communication Technology Integrating Robot Controller Communication Method in Communication Engineering

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Following the ongoing advancement of the communication industry, data traffic and information have achieved rapid growth. As the core technology of contemporary mobile communication, 5G technology can not only meet the transportation needs of massive data traffic but also be expanded to various industries, expanding the development field of intelligent communication and realizing further improvement of production efficiency. At present, 5G mobile communication technology is widely used in communication engineering, providing effective technical support for engineering construction and operation. However, while the progress of the times brings innovation and refinement in mobile communication technology, it also increases the complexity of market development, in this context, the practical application of 5G technology in communication engineering is limited, which limits the development of both. In order to solve this dilemma, this paper integrated the communication method of the robot controller, and based on the analysis of the characteristics and application status of mobile communication technology, the application of 5G technology in communication engineering was deeply studied. In order to prove the effect of the robot controller communication method, in this paper, simulation experiments were carried out to analyze the application effect of 5G in communication engineering from three aspects of throughput rate, energy efficiency, and signal suppression effect and to compare it with traditional communication methods. The results of the signal suppression experiment showed that the average peak value of the signal under the traditional communication method was 18.134 dB, and the average peak value of the signal under the method in this paper was 11.296 dB, which showed that the 5G technology integrating the communication method of the robot controller is more practical in communication engineering.

1. Introduction

In the information age, the development of mobile communication technology is becoming more and more mature, which not only improves the efficiency of social production and life but also enriches the material and spiritual life of the masses. With the widespread popularization of 5G technology, the mobile communication industry is gradually developing towards high quality. As an improvement and upgrade of 4G technology, 5G technology can realize the rapid transmission of information data flow in communication engineering, improve the construction level of communication projects, and provide effective guarantee for the subsequent development of intelligent network communication. However, due to the uncertainty of development and the complex market environment and structure, the practical application of 5G technology in communication engineering is not ideal, and there are still many problems in both. Therefore, it is necessary to strengthen the application value of 5G mobile communication technology in communication engineering and improve the development adaptability and matching degree of the two. The communication method of the robot controller plays an extremely critical auxiliary role in the processing of the target task. As a communication mechanism between independent machine systems, it is also of great significance to the realization of the control target. At present, with the in-depth development of robot technology and wireless communication, the communication method of robot controller has achieved good application results and has made achievements in satellite navigation, geological survey, and other professional fields. It can improve the stability of communication and is of great significance for promoting the application and development of 5G technology in communication engineering.

In recent years, 5G mobile communication technology has been widely used in communication engineering, and many scholars have carried out research on it. Bhattacharjee proposed a 5G mobile communication authentication technology system based on artificial intelligence and applied it in communication engineering to solve the corresponding uncertainty problem [1]. Hussain and Audah proposed hard-decision decoding for orthogonal frequency division multiplexing systems to improve the data reliability of 5G mobile communication technology on multipath fading channels in communication engineering [2]. Gharsallah et al. proposed a new optimized vertical handover method to improve the service quality of 5G mobile communication technology and realize seamless vertical handover in communication engineering [3]. Abbas et al. believed that 5G network can achieve extremely low latency and high-speed data transmission and introduced its application and latest development in communication engineering [4]. In order to enhance the manageability and resilience of future 5G in communication engineering, an end-to-end hybrid satellite-terrestrial network was proposed by Zhang et al. [5]. Mowla et al. proposed an energy-efficient communication model for 5G heterogeneous networks to minimize power consumption while satisfying user quality of service requirements in communication engineering [6]. It can be seen that the application of 5G mobile communication technology in communication engineering is relatively mature, but most studies have explored it at the theoretical level. In order to pay attention to its practicality and improve its application value, the robot controller communication method is a more intelligent choice.

As one of the core parts of the robot, the communication method of the robot controller is of great significance. Pandey et al. used the augmented reality controller to innovate the communication method of the robot controller and realized the better remote interaction effect of the mobile communication technology in the communication engineering [7]. Nguyen et al. described a communication method of robot controller based on quadratic curve path tracking and applied it in mobile communication system, improving communication engineering [8]. The robot controller communication method has achieved good application results in many fields, but the research on the combination with the mobile communication technology is rare. In order to facilitate the further progress of communication engineering, the application research of 5G technology integrating the communication method of robot controller in communication engineering is urgent.

In this paper, combined with the communication method of the robot controller, the application of 5G technology in communication engineering was studied, and the application simulation test was carried out. The throughput rate, energy efficiency, and signal suppression effect of 5G technology in communication engineering applications were compared with those of traditional communication methods. The experimental results showed that in the throughput rate test, the throughput rates of the initial node and the final node under the communication method of the robot controller reached 480 bits and 2911 bits, respectively, which had good data transmission capability. In the energy efficiency test, the range of network health value was 387–453, which had high stability and work efficiency. In the signal suppression test, the overall average value of signal peaks under the traditional communication method reached 18.134 dB, while the overall average value of signal peaks under the robot controller communication method was only 11.296 dB. It can be seen from the experimental data that the 5G technology integrating the communication method of the robot controller has strong application feasibility in communication engineering.

2. Application of 5G Mobile Communication Technology in Communication Engineering

2.1. Overview of 5G Mobile Communication Technology. 5G mobile communication technology refers to a new generation of new technology system after 4G mobile communication technology. As an improvement and upgrade of 4G technology, it provides more convenient and fast mobile communication services for human society. Its basic structure is shown in Figure 1. With the development of communication engineering construction, 5G technology has gradually entered the field of vision of the public. Many countries or organizations with relatively mature mobile communication industries, including China, have successively started the research and deployment of 5G mobile communication technology.

In comparison with 4G technology, 5G technology greatly improves the speed of data delivery and resource utilization by virtue of its unique advantages such as high capacity, high stability, low latency, and wide coverage, which have greatly improved the efficiency and convenience of production and life. Its parameter standard is shown in Table 1.

As can be seen from Table 1, 5G technology has strict high standards compared with previous mobile communication technologies in terms of technical performance. Its standard frequency spectrum is mainly in the middle and high frequency bands, which can provide users with a better experience, promote the continuous progress of communication engineering, and bring it more development space. However, with the improvement of parameter standards, its transmission loss is constantly increased, and the coverage cost is increasingly high, so it must be supported by a number of core technologies [9]. At present, the key technologies in 5G mobile communication recognized by the industry include filtered-orthogonal frequency division multiplexing (F-OFDM), software-defined wireless network technology, massive multiple-input multiple-output (massive MIMO), ultra-dense cellular, and device to device (D2D), as shown in Figure 2.

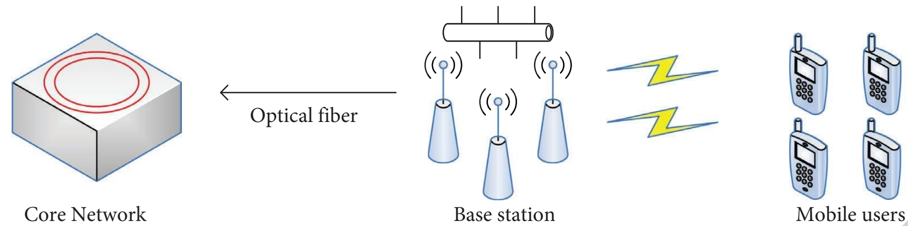

Figure 1: 5G mobile communication technology basic structure.

Table 1: 5G mobile communication technical parameters.

Sequence	Item	Specification
1	Standard spectrum	3.3–39 GHz
2	Communication frequency band	3.3–3.6 GHz and 4.8–5.0 GHz
3	Wavelength	mmWave
4	Transfer method	1–10 mm
5	Supported access rate	10 GP/s

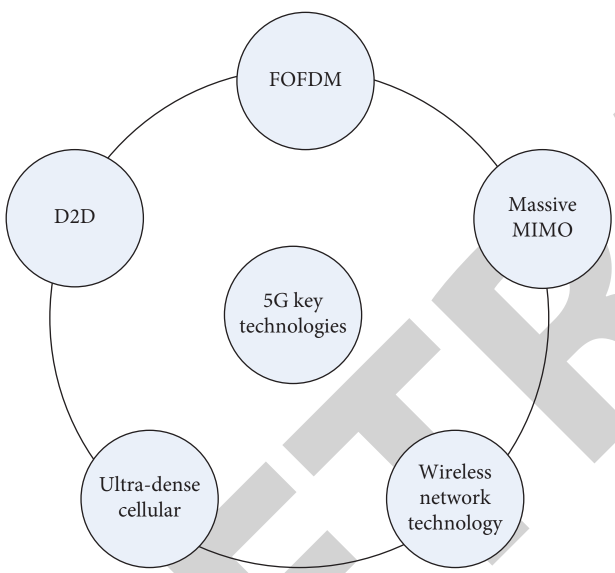

Figure 2: Key technologies in 5G.

Under the support of these key technologies, 5G technology not only includes various advantages of 4G technology but also is able to fulfill market developments and the new demands of different users, such as performance demands such as transmission speed and flexibility, as well as service demands including smart home and medical care, which bring different experiences to different users, as shown in Figure 3.

2.2. Application of 5G Mobile Communication Technology in Communication Engineering. Since the mid-1980s, the communication industry has ushered in its own rapid development in the market, and communication engineering has become the construction focus of major operators [10]. With the continuous fierce competition in the telecommunications industry, the cost and risk of communication engineering construction are increasing, and the requirements for the practicability and value of communication engineering construction are also getting higher and higher.

As one of the most popular mobile communication technologies at present, 5G has been widely used in a large number of communication projects, greatly improving the work efficiency and benefits of the project. While improving the quality of communication engineering construction, it makes its operation more intelligent and its functions more flexible. This paper summarizes its application value in communication engineering into the following 4 points.

2.2.1. Network Capacity. At present, the network construction of the communication project adopts a star network structure, and users communicate with each other through the base station and the network to enjoy network services. However, the distribution range and user capacity of each base station are limited, and due to the influence of the network structure, the amount of access and the amount of output are often in an unbalanced state. 5G mobile communication technology can bring extremely convenient user experience to communication engineering (ultra-high access rate, ultra-low latency, ultra-high reliability, etc.), realize direct connection between users, and expand network capacity. In this way, different degrees of data access requirements are met, and cost reduction is achieved on the basis of ensuring data transmission efficiency.

2.2.2. Level of Intelligence. Intelligence is the foundation of communication engineering construction, and 5G mobile communication technology can comprehensively improve the intelligent construction level of communication engineering, for example, to achieve a new level of improvement and promotion in perception and decision making, according to different construction conditions and needs, such as geographical location, user preferences, terminal status and network context, and other characteristics, so that targeted perception and decision making can be carried out and a solution with a high degree of matching can be designed, thereby enabling data-driven feature deployment, resource configuration, and automation.

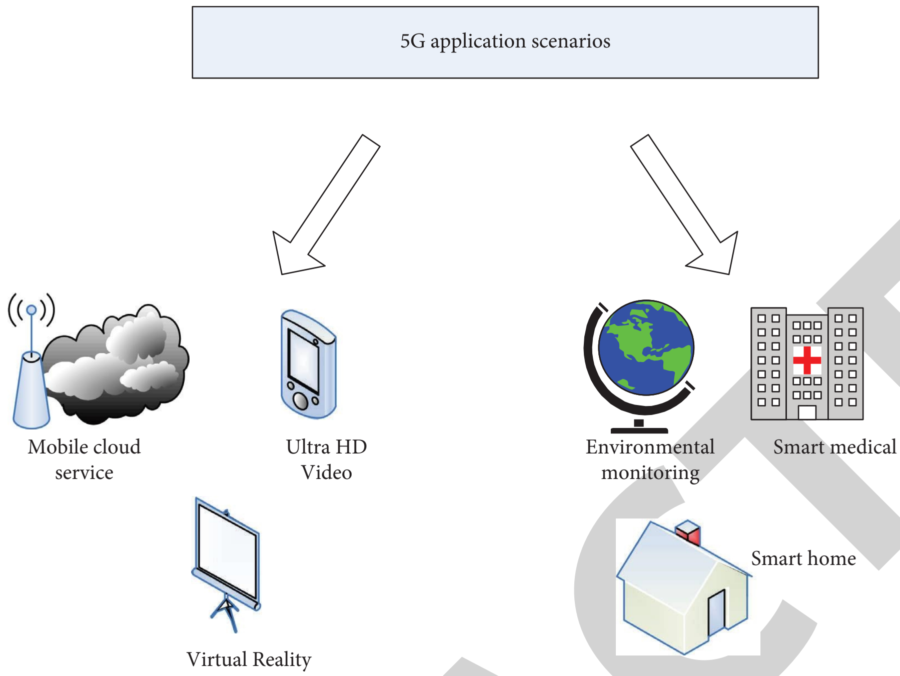

Figure 3: 5G technology application scenarios.

2.2.3. Functional Services. Communication engineering penetrates into all aspects of people's life, study, and work, and its functions and services play an important role in people's daily life. 5G technology supports diversified and rich Internet services and can provide people with more personalized functions and services. In the engineering access network, 5G can realize a variety of network access functions in the form of direct access, including ad hoc network, lightweight, easy deployment, and easy maintenance. Based on the evolution grouping of the engineering core network, it can also simplify and reorganize the functions of the network, which makes the control and forwarding capabilities of the network more flexible and effective.

2.2.4. Network Environment. 5G mobile communication supports the application development of new network ecological industry and vertical industry with a more open technical space. It provides a flexible service deployment environment for third parties through open network functions, enabling good interaction between communication engineering and third-party applications. The 5G network can meet the individual needs of communication engineering entities, create conditions for enterprises' business activities and network service innovation, and thus enhance the ecological value of the network environment.

2.3. Method of Robot Controller Communication. From the analysis of the characteristics of 5G technology and its application in communication engineering in this paper, it can be seen that 5G mobile communication technology plays a crucial role in the construction of communication engineering. However, in the actual application process, the existing 5G technology system still has many serious problems, such as excessive signal peaks appearing in communication engineering construction which can increase the pressure of data transmission invisibly, resulting in poor transmission effect, or the high-performance level of 5G mobile communication technology leading to excessive energy consumption of communication engineering and uniformity of resource allocation in daily operation [11]. These problems make communication engineering unable to adapt to the market development requirements and seriously affect its follow-up development. For this reason, this paper improves the problems generated by combining the communication method of the robot controller.

Robot controller communication is an important branch of robotics development in recent years. Its main working principle is to use the robot to perceive the surrounding environment information and to exchange and integrate information with the controller in real time [12]. The technical method is based on a wireless network. On the one hand, operations can be performed to improve work efficiency, and on the other hand, redundant information can be used to ensure the stability of the system. Robot controller communication has the following 4 characteristics.

2.3.1. Randomness. During the communication process, it is usually unpredictable which node the robot target node can establish a connection with or when the connection can be established [13].

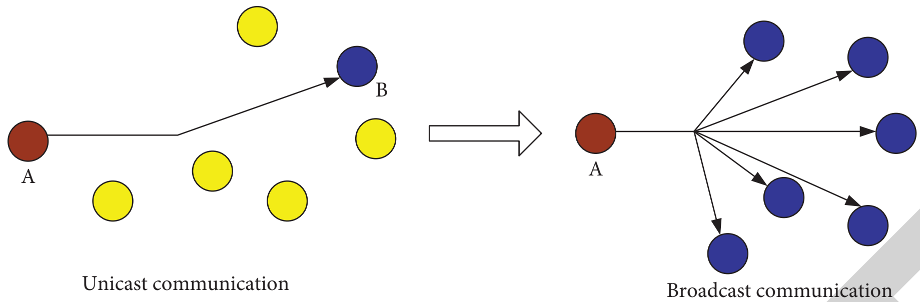

FIGURE 4: Robot controller communication method.

2.3.2. Discontinuity. The communication constructed by two independent machine systems cannot maintain a long-term state but can only be maintained for a short period of time. After the communication target is completed, the controller can automatically interrupt the communication [14].

2.3.3. Locality. In order to effectively ensure the operation of the communication mechanism in the follow-up work, it is necessary to reduce a certain amount of energy consumption. Therefore, the communication of the robot controller is only established locally in a single robot system.

2.3.4. Dynamicality. The network topology structure constructed by the communication system changes dynamically.

There are two main communication methods for the robot controller: unicast communication and broadcast communication, as shown in Figure 4.

As can be seen from Figure 4, unicast communication requires the establishment of a separate data channel between robots, and data packets sent from one node A can only be sent to one node B. If other nodes can also receive A's information, A must continuously generate multiple identical messages to send, which can cause a waste of computing resources and a large delay for a single robot. However, the broadcast communication is a "one-to-all" communication mode. Node A can send the data packet to all nodes within the communication range without choosing a special path, and other nodes only need to monitor whether there is information coming [15]. The cost of this design method is very low and is well adapted to the communication requirements of 5G technology in communication engineering applications. Therefore, this paper uses broadcast communication to conduct research on the implementation of 5G in communication engineering.

In order to facilitate the analysis, the number of time slots included in the transmission process of each frame of the communication engineering data channel is set to N. These time slots are synchronized by the robot controller. Labels can be set in advance, and the time slots are selected through the label extraction to ensure randomness [16]. Assuming that n is the preset number of tags, the selection of the time slot requires the tags to be extracted in the time frame with a probability order of $1/N$. After selection, the target communication data are sent by the time slot. The probability that k tags in a time slot simultaneously send target communication data can be calculated as follows:

$$P(k) = \binom{n}{k}\left(\frac{1}{N}\right)^{k}\left(1-\frac{1}{N}\right)^{n-k}. \quad (1)$$

The number of tags that can be successfully identified in a frame is as follows:

$$N \cdot P(1) = N \cdot \binom{n}{1}\left(\frac{1}{N}\right)^{1}\left(1-\frac{1}{N}\right)^{n-1}. \quad (2)$$

The throughput rate of the communication engineering system is defined as follows:

$$T(n, N) = \frac{N_t}{L_f} = P(1). \quad (3)$$

Among them, N_t is the number of labels identified in a frame. L_f is the frame length of the current frame. $T(n, N)$ is related to n, N. When the throughput rate T of the communication engineering system is the highest, $\partial P(1)/\partial n = 0$, and the solution is as follows:

$$n = \frac{1}{\ln N/N - 1} = \frac{1}{\ln(1 + 1/N - 1)}. \quad (4)$$

When the number of tags is approximately equal to the frame length, the throughput rate of the communication engineering system reaches the maximum.

If the distribution function of the number of tags has been obtained, the average value of the random variable of the throughput rate of 5G technology in communication engineering can be calculated as follows:

$$E(S) = \sum_{n=0}^{n_{\max}} T(n, N)P(n). \quad (5)$$

Once the distribution function of the number of tags is determined, information exchange can be carried out through the communication components under the controller to select the appropriate time frame length to maximize the average value of the random variable of the throughput rate. At this point, it is assumed that the number of tags around the communication component of the robot controller in a given time range approximately obeys a Poisson distribution:

$$P(n = k) = \frac{\lambda^k}{k!}e^{-\lambda}. \quad (6)$$

The data information to be acquired includes the number of time slots in different states (collision, success, and vacancy) of the current time frame, and the robot controller can complete the effective prediction of the number of tags based on the number of time slots in different states [17, 18]. Taking the number of time slots obtained in the latest frame as an example, it can be calculated according to the following formula:

$$P(n|I) = \frac{P(I \cap n)}{P(I)} = \frac{P(I \cap n)P(n)}{P(I)}. \quad (7)$$

In the same frame, $P(I)$ is usually regarded as a constant, which can be normalized and eliminated in the actual calculation of the average value of random variables.

According to the probability distribution function of the number of updated tags and the number of tags that have been successfully identified, the length of the next frame can be adjusted. If there are S tags in the t-th frame that are completely recognized by 5G mobile communication technology, then in the state without any new changes, the distribution function of the $t+1$-th frame can be obtained according to the following formula:

$$P_{t+1}(n - S) = P_t(n|I). \quad (8)$$

The average value of random variables of the number of labels in $t+1$ frames is calculated according to the distribution function, as shown in the following formula:

$$E_{t+1}(n) = \frac{\sum_{n_{\min}}^{n_{\max}} (n - S)P_{t+1}(n - S)}{\sum_{n_{\min}}^{n_{\max}} P_{t+1}(n - S)}. \quad (9)$$

When the communication component of the robot controller tries to identify the label, there is a certain rule in the number of labels in the previous frame, the current frame, and the next frame [19, 20]. The 5G mobile communication technology under the traditional communication method often ignores this law, which only performs the subsequent operation of the communication project according to the information identified in the latest frame, while the robot controller communication method can record the law between the number of tags inside the system. In the follow-up operation, this law can be extracted for prediction and guidance, so as to minimize the power consumption of communication engineering and improve its usability.

2.4. Application Simulation of 5G Mobile Communication Technology in Communication Engineering. In order to prove the practicability of 5G technology under the communication method of robot controller in communication engineering, this paper used the MATLAB platform to conduct simulation experiments and tested the throughput rate, energy efficiency, and signal suppression effect of 5G in communication engineering application simulation. In order to directly reflect the effect of the method, the application effect of 5G technology in communication engineering under the traditional communication method was compared. The experimental scene design conditions are shown in Table 2.

Table 2: Experimental scenario design conditions.

Sequence	Item	Specification
1	Maximum number of nodes	100
2	Regional area	100 m * 120 m
3	Base station location	(50, 100)
4	Node communication radius	20 m

2.4.1. Test of Throughput. The throughput rate of 5G technology in communication engineering refers to the maximum amount of data that the engineering equipment interface can accept and transmit without any communication abnormality. As a limit index, the throughput rate has an extremely important reference role in judging the construction effect of communication projects. By setting different numbers of nodes (50, 60, 70, 80, 90, and 100), this paper investigated the throughput of 5G technology in communication engineering under two methods. The results are shown in Figure 5.

Generally speaking, the larger the number of nodes, the greater the tuning probability of the network, and the throughput rate can also increase, which can be seen from the test results of the two methods in Figure 5. However, from the perspective of the overall test results and the degree of change, the throughput test results of the 5G technology integrating the communication method of the robot controller in the communication engineering had more obvious advantages. In Figure 5(a), the throughput rate of the initial node reached 480 bits per second, and as the number of nodes continued to increase, the throughput rate also increased. When the number of nodes was 100, the throughput rate reached a maximum of 2911 bits per second, indicating that the 5G mobile communication technology under the communication method in this paper can make full use of the network environment, effectively transmit data traffic, and provide good support for the normal operation of communication projects. In the test results of the traditional communication method in Figure 5(b), in the initial stage when the number of nodes was 50 and 60, the throughput rates were slightly higher than the test results under the communication method in this paper, which were 491 bits and 627 bits, respectively. However, when the number of nodes reached 70, its advantages no longer appeared, and the subsequent throughput results were far from the method in this paper. This might be related to the network environment, and the increase in the number of nodes led to a complex network environment. The 5G mobile communication technology under the traditional communication method cannot filter the interference factors in it well, which affected the normal transmission of communication engineering data and affected the throughput results. From this aspect, the throughput performance of our method was indeed impressive.

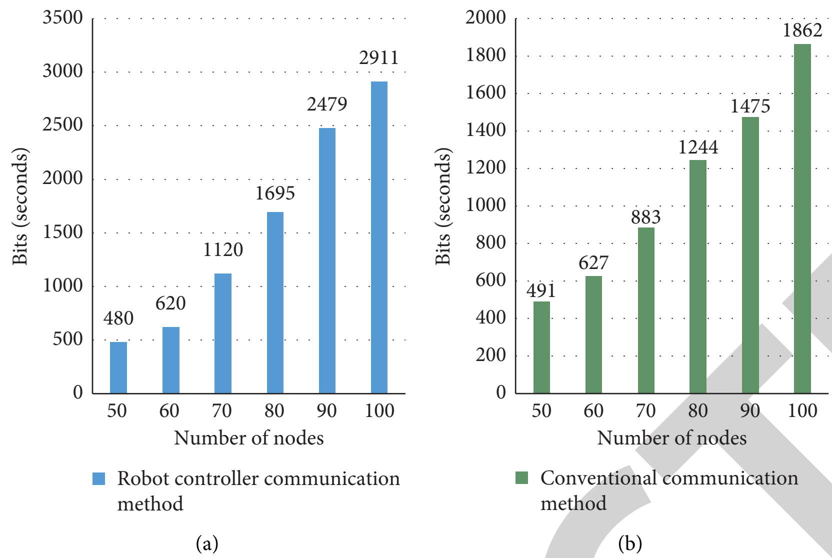

Figure 5: Test results of throughput. (a) The results of this communication method. (b) The results of the traditional communication method.

2.4.2. Test of Energy Efficiency. The energy efficiency test mainly examines the energy resource utilization efficiency of 5G technology in communication engineering. At present, the construction of market communication engineering has been carried out in a comprehensive manner. Under the environment of imbalance between supply and demand, the utilization of communication engineering resources is extremely critical. The energy efficiency test conditions in this paper are shown in Table 3, and the test results are shown in Figure 6.

From the energy efficiency test results in Figure 6, the energy resource utilization efficiency of the 5G mobile communication technology under this method in communication engineering was significantly higher than that of the traditional communication method. In Figure 6(a), the fluctuation range of the results of the robot controller communication method under 50 rounds of simulation tests was relatively small and was basically maintained within the range of 387–453. However, under the traditional communication method in Figure 6(b), the test result range fluctuated greatly, and the network life was short, with the range of 297–379. The highest point of life value was lower than the lowest point of this method. From the perspective of network life time, the 5G mobile communication technology integrating the communication method in this paper prolonged the life of the communication engineering network, and its energy efficiency was high. The communication method of the robot controller could simultaneously take into account the energy and density of the communication engineering network nodes in the subsequent operation and manage and optimize them in real time, reducing unnecessary energy consumption of 5G mobile communication technology to achieve better energy efficiency and resource allocation in engineering construction, which is where traditional communication methods are difficult to break through.

Table 3: Test conditions of energy efficiency.

Sequence	Item	Specification
1	Raw energy of the node	2 J
2	Length of packet	6 kbit
3	Energy parameter	60 nJ/bit
4	Error level	120 nJ/bit/square meter
5	Rounds of simulation	50

2.4.3. Effect of Signal Suppression. Signal suppression refers to the effect of 5G on the suppression of high signal peaks of transmitted data in the actual operation of communication projects. Different number of carriers, which were 4, 16, 64, 256, and 1024, respectively, were set in the experiment in this paper. Under different conditions, the signal peak suppression effect of 5G in communication engineering was observed. The results are shown in Figure 7.

In the data transmission of communication engineering, abnormal signal peaks are easily generated. Excessive signal peaks can cause more significant spread spectrum interference and signal distortion inside the system, which can not only increase the operational complexity of communication engineering but also affect its work efficiency. Therefore, it is necessary for mobile communication technology to suppress it. From the results in Figure 7, although the signal peaks all showed a rising trend with the increase of the number of carriers, the signal suppression effects of the two methods were different. In Figure 7(a), the signal peaks under different carrier numbers were 4.11 dB, 6.79 dB, 9.32 dB, 14.44 dB, and 21.82 dB, respectively, and the overall average value was 11.296 dB. In Figure 7(b), the signal peaks under different carrier numbers were 6.03 dB, 12.77 dB, 18.32 dB, 23.74 dB, and 29.81 dB, respectively, and the overall average value reached 18.134 dB. From these data, it can be seen that the

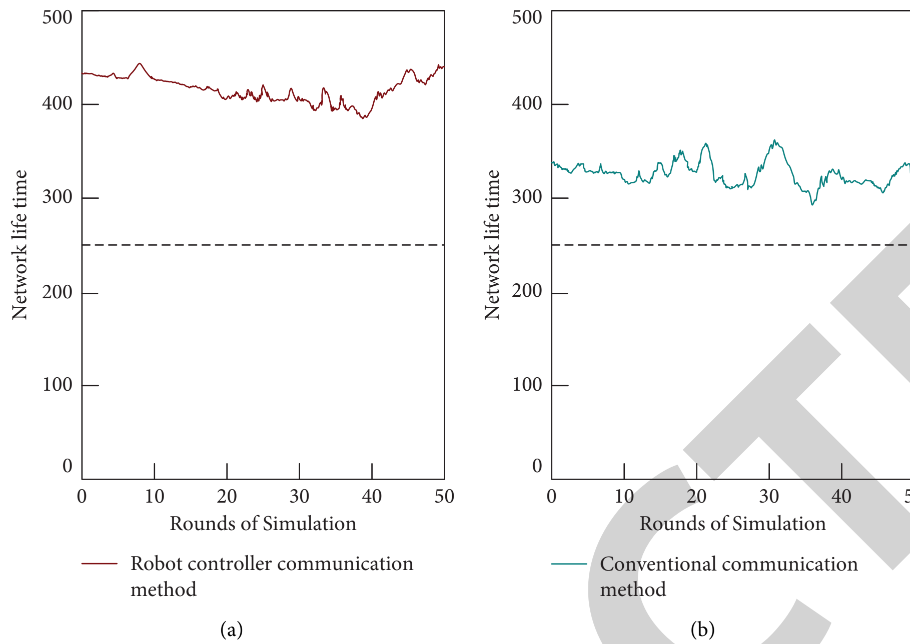

FIGURE 6: Test results of energy efficiency. (a) The results of the communication method in this paper. (b) The results of the conventional communication method.

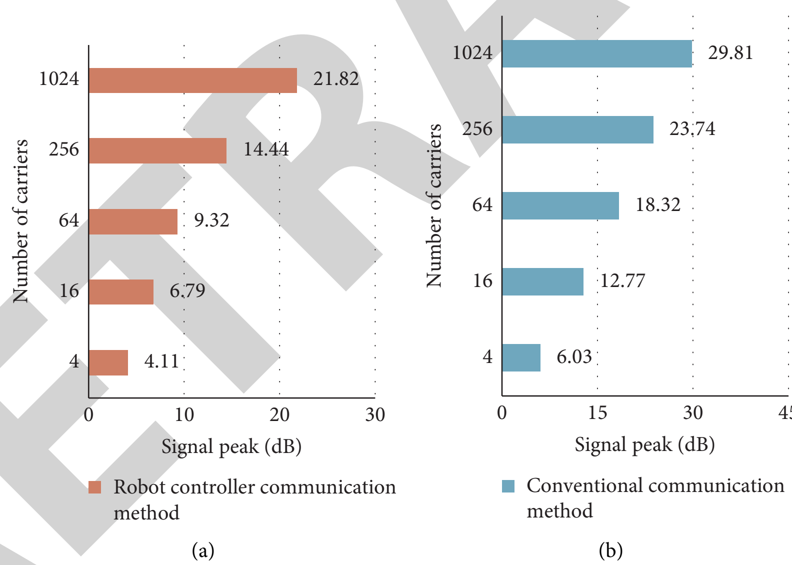

FIGURE 7: Test effect of signal suppression. (a) The results of the communication method in this paper. (b) The results of the conventional communication method.

5G technology that integrates the communication method of the robot controller can reduce the impact of signal peaks on communication engineering within a reasonable range. Even under more extreme peak conditions, the communication system can be guaranteed to operate stably and achieve good gain. Although the traditional communication method has a certain inhibitory effect on the signal peak, it has many limitations. Especially in the dynamic frequency switching, the weakened peak is very likely to be regenerated.

3. Conclusion

With the changing application scenarios and business requirements, the market has higher and higher requirements for the application value of 5G technology in communication engineering. Giving full play to the advantages of 5G technology, accelerating communication efficiency, and strengthening the construction of communication projects are the key directions of current development. In this paper, the communication method of the robot controller is combined, and the application of 5G technology in communication engineering is deeply studied. From the perspective of practical application, this paper improves the practicability and value of 5G technology. While improving data transmission efficiency and energy efficiency, it solves the problem of performance impact caused by excessive peak signal and ensures the stability and innovative development of communication engineering. Although the research in this paper solves the development problems of the current communication industry from many directions, due to the limitations of time and conditions, this paper needs to be improved. There are still some problems especially in the experimental test. The test of the application effect needs to be carried out according to the actual operating state. This paper only observed from the perspective of simulation analysis, and the research scope of this paper needs to be expanded. In the follow-up research, key research needs to be carried out on these problems and deficiencies, and the experimental methods and conditions can be continuously improved to enhance the application effect of 5G technology in communication engineering.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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