Artificial Intelligence in 5G NR Communication Development

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Abstract. Artificial intelligence is a discipline composed of computer science, control science, belief science, language theory, neurophysiology, psychology, mathematics, philosophy, etc. With the rapid and complex development of modern science and technology, 5G network continues to develop. 5G network has more advantages than 4G network: lower delay, more connections and higher speed. The purpose of this paper is to study the application of artificial intelligence in 5G NR communication development. This paper first introduces 5G communication technology and analyzes its outstanding feature; secondly, the development status of AI is introduced, and the development of AI in 5G communication field is predicted and discussed. Finally, the coincidence processing method, sub-symbol processing method and horizontal processing method are put forward, and the hardware experiment of robot intelligent control system is carried out. In this paper, through the comparison experiment and simulation experiment of VM virtual machine and Docker container technology; Finally, the experimental results show that artificial intelligence accounts for more than 30% in the development and application of 5G NR communication.

Keywords: Artificial Intelligence, 5G NR Communication, Development and Application, Clustering Algorithm

1. Introduction

1.1 Background and Significance
With the rapid and complex development of modern science and technology, 5G network continues to develop. 5G network has more advantages than 4G network: lower delay, more connections and higher speed. For today's artificial intelligence, this advantage is particularly ideal: fast and accurate computing enables you to communicate with people more easily, while artificial intelligence supports the network of daily applications running with 5G. 5g network is a wide range, which is very suitable for supporting physical network communication, and it fundamentally changes the way many daily activities are carried out [1-2]. Application examples are in the fields of transportation, manufacturing and healthcare. 5G brings people not only virtual convenience, but also great influence on daily life style. As the next generation wireless communication technology, the fifth generation communication (5G) will bring revolutionary changes to our lives. The 5G mobile network will include many wireless access technologies, such as LTE, 5G NR and WLAN. Therefore, when the user equipment moves in a 5G heterogeneous network, it will be connected to different types of base stations [3]. With the rapid
development of information technology and computer network technology, the era of artificial intelligence has arrived [4]. Organizational communication in the era of artificial intelligence development is both an opportunity and a challenge. The purpose of artificial intelligence is to create intelligent machines on the one hand, and to understand the essence of human intelligence on the other, so artificial intelligence belongs to both engineering and science. Research and development of artificial intelligence can help, partially replace or even expand human intelligence, and make computers better for human beings [5].

1.2 Related Work
Information and communication technology is one of the basic characteristics of modern society. Zhang W believes that 5G and AI (Artificial Intelligence) are changing industrial production and providing great potential for manufacturing enterprises [6]. Artificial intelligence (AI) is the cognitive ability of computer or machine to think and learn. The urgent task is to evaluate the extent to which artificial intelligence can integrate emotional intelligence, which is considered to be the promoter of enhancing Millennium participation [7]. Machine learning and general artificial intelligence are becoming necessary conditions for further expansion beyond the 5G mobile world [8]. The use of Suganthi B millimeter wave frequency is one of the key strategies to realize the amazing 1000 times increase in the capacity of future 5G wireless systems [9]. It is generally believed that the progress of edge learning will provide a platform for realizing edge artificial intelligence in 5G and above systems, and solve large-scale problems in our society from autonomous driving to personalized medical care [10]. Under the background of 5G technology, artificial intelligence has undoubtedly entered another step. However, at present, 5G technology has just started and is not very mature, and how to apply 5G technology into artificial intelligence is also a big problem, so there is still a long way to go for the application of artificial intelligence in 5G NR communication.

1.3 Main Contents
Based on the application of eMBB, uRLLC and mMTC defined by ITU, the network is larger and more complex than ever in terms of large-scale antenna array, new network architecture, new multiple access technology, ultra-dense network technology and 2D communication technology. Dynamic and rapidly changing business makes it impossible for people to set parameters and make use of experience to formulate strategies to meet their needs. Combining 5G network with AI can improve the intelligence of 5G network, thus making it possible to automatically create policies and parameters.

Through the study of artificial intelligence and 5G technology, on the basis of consulting a large number of documents and materials, this paper has carried out the following research:

The first chapter mainly introduces the development prospect and present situation of the application of artificial intelligence in 5G NR communication development, as well as the research purpose, significance and related work of this paper.

The second chapter introduces the application of artificial intelligence in 5G NR communication development by coincidence processing, sub-symbol processing and horizontal processing.

In chapter 3, the hardware experiment of robot intelligent control system is introduced to deeply study this paper, and the research direction of artificial intelligence in the future is comprehensively analyzed.

The fourth chapter introduces the comparison experiment and simulation experiment of VM virtual machine and Docker container technology, and introduces and analyzes the data in detail.

The fifth chapter summarizes the specific work of this paper on the application of artificial intelligence in 5G NR communication development, and looks forward to the next step.

2. Method of Artificial Intelligence in 5G NR Communication Development

2.1 Symbol Processing Method
They are based on the hypothesis of Newell and Simon's physical symbol system. Most so-called "classic artificial intelligence" is guided by it. In this type of method, the logical operation method is the recommended knowledge base. This kind of artificial intelligence style uses the description of declaration to express the "knowledge" of domain problems, which is based on or basically equivalent to the declaration in the first line of logic, and uses logical logic to draw conclusions about the knowledge results. There are many variations of this method, including those that emphasize the Apog form of logical language. This method requires a good understanding of problem areas in terms of "practical problems", which is often called knowledge-based method.

2.2 Sub-Symbol Method
In the second category, there is a method called subclass. A bottom-up approach is usually used, starting from the lowest stage. At the bottom, the concept of characters is not as precise as that of signals. The emphasized method is animation method. People who prefer this kind of intelligence think that we must follow this evolutionary progress in order to create real artificial intelligence on the earth for millions of years or longer. Therefore, we must pay attention to the advantages of simple animals such as signal processing and insects, and follow the evolutionary stage. This scheme can not only create a useful amulet in a short time, but also lay a solid foundation for the establishment of high intelligence. The specific calculation method is as follows:

If satisfied \( \int_{m}^{n} x^2 + \log x > n \), and \( |M(n)-(n+1)| > 10 \), the formula is adjusted to \( M(n) \):

\[
\sum_{i=\alpha}^{n} n^2 + 5n
\]

In which \( m \) is the application amount of 5G NR communication technology and \( n \) is the application amount of artificial intelligence in 5G NR communication technology.

2.3 Clustering Method
In the cloud computing resource load system, the load of adjacent time points will not change dramatically, Therefore, compare the data of the current time point with the data of the two adjacent time points before and after. If the difference between the load data of the two time points exceeds the given threshold, it is considered that there is a deviation in the data of this point, which needs to be adjusted to make the data smoother. The processing method is as follows:

Adjust \( L(t) \) according to the following formula if \( |L(t)-(t-1)| > \alpha \) is satisfied.

\[
L(t) = \frac{L(t-1) + L(t+1)}{2}
\]

In the formula, \( L(t) \) represents the load value at time \( t \), and \( \alpha \) represents the threshold value.

3. Experiment of Artificial Intelligence in 5G NR Communication Development
In this chapter, the hardware experimental platform of the robot intelligent control system is set up first, and then the software interface design is introduced. Finally, the test results are given by running the robot control system experimental platform software. According to the performance requirements, an experimental platform is designed and built, and the selection of core components and design sources are explained in detail. The design of software interface and its realizable operations are introduced in detail, including initialization of motion controller, interface data display, opening of simulation interface, opening and saving of data files, etc. The results of position control of 2R robot are analyzed, and the position error of each joint of 2R robot is obtained. The simulation object is planar 2R robot, and the influence of friction on motion control is not considered, The relevant simulation parameters are shown in Table 1.
Table 1. Simulation Model Parameters

| Pole 1 | m1  | mc1 | l1  | r1  |
|--------|-----|-----|-----|-----|
| Data   | 0.81| 0.2 | 200 | 100 |
| Pole 2 | m2  | mc2 | l1  | r2  |
| Data   | 0.51| 0.2 | 200 | 100 |

In the table, the mass unit is Kg and the length unit is mm, m1 and m2 are concentrated masses at joints 1 and 2, mc1 and mc2 are the masses of rods 1 and 2, l1 and l2 are the lengths of rods 1 and 2, and r1 and r2 are the centroid positions of rods 1 and 2. Assuming that the end point of the robot moves from the initial position (400,0) P0 to the target position (250,150) Pd, a set of solutions can be selected from the angle of joint motion acceleration, position and convenience for observation. The selected values are shown in Table 2 and Figure 1.

Table 2. Simulation Position Parameters

| INITIAL VALUE | A1    | A2    | X          | Y     |
|---------------|-------|-------|-------------|-------|
| TARGET VALUE  | -75.07°| 85.82°| four hundred| 150   |

Figure 1. Simulation Position Parameters

4. Experimental Results

4.1 VM Comparative Experiment of VM Virtual Machine and Docker Container Technology

When the container application stops in the media slot holder, only the application container image occupies a large space, while the traditional virtual machine does not delete files when it stops, and its storage capacity is much larger than that of the container. The container uses standard interprocess communication (IPC), and can also use Ethernet communication through the host. However, the virtual machine can only communicate with Ethernet, the docking container runs on the host kernel, and the virtual machine runs on the hypervisor. Docker is a lightweight virtualization solution with slightly higher performance than virtual machine virtualization. See table 1 for the performance comparison between virtual machine and docking container. In this table, a server uses 4 processors (8
cores per processor, 3.2 GHz), 256 G memory and 1 TB external storage as testers. Install virtual machine software 5.1 and deploy CentOS6.5 virtual machines in the virtual machine environment. Install CentOS6.5 system at the bottom of Docker container environment, deploy Docker engine, and apply Tomcat middleware. The specific results are shown in Table 3:

| trait                        | VMware Workstation VM10.02 | Docker container       | VMware Workstation VM10.02 | Docker container       |
|------------------------------|----------------------------|------------------------|----------------------------|------------------------|
| Starting speed               | 60 s                       | 4 s                    | Minute level               | Second order           |
| Hard disk usage              | 20 GB                      | 300 MB                 | GB                         | MB                     |
| performance                  | 43%                        | 87%                    | Ruoyu native               | Close to native        |
| System support               | 46                         | 570                    | dozens of                  | Hundreds of containers |
| isolation                    | Safe isolation             | Safe isolation         | Safe isolation             | Safe isolation         |

The comparison test results between the container and the virtual machine show that the container does not need the operating system layer, and the container has great advantages.

4.2 Simulation Experiment

Figure 2 shows the simulation results of encryption work. The number of attributes deleted during simulation is expected to be fixed. As the number of password text attributes increases, this number increases the encryption overhead again. Simulation results show that the solution does not re-encrypt the attributes that have not been deleted. After revoking an authorized user, the system only updates the key material corresponding to the deleted attribute of the revoked user. This effectively improves the elimination efficiency. It can also reduce the overhead of encryption process. Simulation results show that the scheme provides updated data encryption with lower overhead in the re-encryption stage, and ensures the security and practicability of the locking process. The data is shown in Figure 2:

![Figure 2. Simulation results of encryption work](image_url)

The simulation results show that the comprehensive energy can be greatly optimized by computer technology and virtual synchronous machine technology, such as collecting and analyzing energy information, establishing system configuration mathematical model, establishing operation adjustment control model, adopting particle swarm optimization algorithm, multi-objective decision algorithm and
system judgment adjustment model, which proves the feasibility of computer technology and virtual synchronous machine technology in new energy application.

5. Conclusions
In short, 5G communication technology has become an indispensable technical means for people's production and life in the future because of its powerful systematization, high spectrum utilization, low energy cost and the use of double-sided signals. Artificial intelligence technology also plays an irreplaceable role in the future development of information society. Therefore, the application of artificial intelligence technology in the field of 5G communication is also helpful to promote the development of everything in people's lives and enable human society to develop in an intelligent society under the background of connected cloud life and intelligent interaction. Nowadays, China has a certain leading position in 5G communication technology, but its application remains to be studied. Artificial intelligence definitely plays an important role in the application of 5G technology. China's research on this aspect is just beginning, and with the advancement of research, the application of artificial intelligence in 5G communication technology will become the main research trend in the near future.

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