Monitoring and early warning of artificial intelligence system in public health safety law

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Research Article

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Abstract

With the development of communication technology, the birth of 5G technology has epoch-making significance for data transmission and storage. Because of its very large network bandwidth and small network delay, it is very reliable in data transmission. 5G and other engineering, such as artificial intelligence and other technologies are often linked together, from the technical means and data transmission efficiency and other aspects of the technical level, promote and make artificial intelligence technology can be further expanded and extended. Based on this, the application and development of 5G technology and artificial intelligence under the background of new era information technology are expanded and studied in this paper. In addition, based on the prediction process of deep neural network construction, this paper studies its operability on FPGA platform from this process, and carries out a series of related studies on the implementation means of neural network on FPGA platform. In this paper, an accelerated system is designed, and the model can be established based on the key factors extracted from the accelerated system. Applying models set under different acceleration systems in different scenarios can be suitable for different network architectures. In the final research phase, we analyzed the materials and performed experimental verification. In the context of the market economy, we elaborated on the responsibility of the government in a certain region to maintain public security. For a region, it needs to be based on local actual conditions, specific analysis of specific issues, learning from the experience of some areas where public health incidents are handled well, and establishing a system with local characteristics. From the process of elaboration, we found that public health safety is not only closely related to each of our lives, but also further related to social stability and security.

1. Introduction

5G technology is still in the development stage, and technical personnel are constantly practicing and want to further increase the performance and application scenarios of 5G technology [1]. Using certain technical means and model layout planning, 5G technology and artificial intelligence technology can be integrated in a whole or part, and the scope of artificial intelligence technology and 5G technology can be expanded, so as to promote the collaborative progress of the two technologies in the technology development history of the new era [2]. The combination of 5G technology and artificial intelligence technology can build a more intelligent smart city, and the system can also build some industrial systems with a higher degree of automation [3]. For technological development, the integration of 5G technology and artificial intelligence technology is particularly important, which can not only promote its further development, but also be applied to actual life scenes, with strong characteristics of The Times [4]. FPGA software has flexibility and high performance in the calculation process [5]. In the process of practical application of the platform, we can choose different projects to configure the FPGA system according to the actual situation. Due to its high efficiency and flexibility, FPGA has been widely used in some calculation processes and system verification. In some areas of our country, FPGA has been used for research and system development [6].

In the context of economic globalization, both the development of the market economy and the development of commercial activities have been developed to a large extent, and commodity trade exchanges from all over the world have also become more frequent with the development of the economy. In the economic field, countries in the world seem to have no borders, which has led to the rapid spread of various infectious diseases and health problems [7]. Public health problems used to be only regional outbreaks, but now as people's communication is getting closer, once public health safety problems arise, it will lead to global proliferation. Under such conditions, safety prevention and control has become a critical task [8]. In this context, my country has included public health security as a component of national security, and attaches great importance to public health security and political and economic security [9]. At the beginning of the 21st century, public safety issues broke out all over the world. Everyone has an updated understanding of public safety issues. After experiencing safety issues, our country's attention to public health safety has reached its peak [10].

2. Related Work

Literature mainly summarizes the literature and materials studied by the ancestors, analyze and describes the conceptual application and current situation of FPGAs. At the same time, the article also describes the process of using FPGAs for development and the use of FPGAs for system development. necessity. It mainly studied the system architecture of FPGA and found that FPGA includes interconnection structure and system configuration structure [11]. The article also analyzes and describes the structural characteristics of commonly used FPGA interconnect structures. The configuration structure of FPGA is mainly divided into two types: distributed type and centralized type. Large-capacity FPGAs usually adopt some high-density packaging technologies, which can reduce the packaging area and make it more reliable [12]. High-density packaging technology can also reduce the cost of the system and solve the problem of insufficient pins. In the process of FPGA interconnection, it can be realized through different board layers. When configuring the system structure, we use a single-configuration chip to have a higher advantage than a multi-configuration chip [13]. It can also further reduce the cost of hardware and facilitate system debugging. It mainly introduces and researches the logic segmentation algorithm of FPGA, which includes multiplexing algorithms such as neural network algorithm and genetic algorithm. For some feedback in the circuit structure, once there is a logic error, a corresponding improved algorithm of genetic algorithm is proposed to solve this problem [14]. It mainly researched and analyzed the system configuration and clock synchronization scheme of FPGA, and proposed a small-scale configuration scheme, which is more suitable for DLL-based system clock synchronization. It mainly studies the way to change the detection performance of radar through pulse accumulation, and realizes digitalization by FPGA, which can be applied in engineering. It analyzes the feasibility of the digital radar receiver designed by FPGA, and puts forward its technical advantages, and conducts an in-depth discussion on the implementation process [15]. It mainly introduces 5G technology, and proposes that 5G technology is a representative technology of contemporary communication technology, and it is also a brand-new technology. It has high performance and can perceive changes in the environment and adjust parameter equipment intelligently [16]. It mainly proposes that the combination of 5G technology and

artificial intelligence technology can solve many problems that people are facing now. Artificial intelligence technology can also better allocate resources and control power [17].

3. Theory And Model Design

3.1. Public health safety based on neural networks

At present, there are still some defects in the field of public health security. The normal development of novel coronavirus and the sudden outbreak of infectious diseases test the development of the public health security management system. Therefore, only by quickly mastering the safety problems at the first time, making timely and effective treatment, and enhancing the early monitoring and warning capacity, can we effectively contain the outbreak of the epidemic, prevent the spread of the epidemic, defuse the major emergency public health security risks, and better protect people's life and property safety. In this study, this paper found that the neural network application in public health and safety management, based on neural network can be a powerful data processing ability, better to protect against early warning, to capture information, timely and make reasonable decisions, thus further improving the public health security prevention and control system, to nip in the bud. The neural network is shown in Fig. 1.

In this paper, when configuring the circuit of FPGA platform, four FPgas are used to work in parallel, which are all from XiLinux chip company. The connection mode of this chip is a semi-symmetric form. In order to enable the FPGA platform to complete the communication task, it also needs to use the DPI interface, and then through the accelerator to complete the communication with the CPU on the host side. It is also necessary to obtain a series of related power consumption data through Vivado, and then use the upper computer to complete the control of the algorithm and the purpose of data transmission, and test the power consumption.

3.2. Logic Division of Multi-FPGA System

Figure 2 shows the relationship between data scale and performance in the FPGA system. The system development of FPGA is affected by chip capacity, so we need to implement logical division for it. The chip system is effectively mapped to the FPGA system for logic simulation, which can solve the problem of unit limitation, and at the same time can improve the performance of simulation and promote the development of FPGA.

We designed a simple combinational logic circuit, as shown in Fig. 3. In the circuit, we input two signals and pass the gate operation, then input another signal to perform the operation together, and finally get the output signal. We map the logic circuit to the FPGA chip. All signals are stored in the FPGA. The two FPGA chips have a connection path. We connect the two chips according to the algorithm. FPGA2 must first obtain the multiplexed signal, and then interact with the output signal in the first FPGA to obtain the final output signal. We can use logical division to get more logic units, even if there is no additional logic unit, two FPGAs can also be connected by pins.

Figure 3 shows the relationship between performance in FPGA and neural network. Some scholars have proposed a logical division method to expand the logic capacity and increase the number of pins. There are two methods for logical division of FPGAs. The first is to divide before mapping, and the second is to divide after mapping. The first segmentation method is to segment based on the source code, so that the entire task can be input into the system for segmentation. However, this method of segmentation is not accurate enough, and the effect of segmentation is not good, and sometimes it cannot be added to the FPGA. The second way of splitting is to split the netlist. This way of splitting is to analyze the structure of the netlist first. This way of comparing too large may consume too much time and overhead. Figure 4 shows the relationship between network structure and system performance in FPGA system.

The feasibility and quality of this algorithm are very high, but it relies too much on the initial division result. Once the initial division result is wrong, the result of the algorithm will have a large error deviation. There are other algorithms for logical partitioning. Figure 5 shows Relation diagram between slice size and system performance in FPGA system.

Suppose you have two independent units, one in set A and the other in set B, and these two sets can form an overall network. Use Ea to express the number of network connections between cell A and set B, and use Ia to express the number of network connections between cell A and set A. They conform to:

$$\mathrm{g_{ab}} = \mathrm{D_a} + \mathrm{D_b} - \mathrm{c_{ab}}$$

1

$$\mathrm{G} = \sum_{\mathrm{i}} \mathrm{g_i} \leq 0$$

2

In the process of unit movement, specific conditions need to be met. After the movement is completed, the unit is locked until the next condition arrives before being released. Repeat this process until:

$$\mathrm{g}\left(\mathrm{i}\right) = \mathrm{F}\left(\mathrm{i}\right) - \mathrm{T}\left(\mathrm{i}\right)$$

3

The constraints are:

$$\gamma \bullet |\mathrm{V}| - \mathrm{S_{max}} \leq |\mathrm{A}| < (1-\gamma) \bullet |\mathrm{V}| + \mathrm{S_{max}}$$

4

It keeps moving until all the units have moved once.

3.3. Multi-FPGA performance model

The running time of the system task includes calculation time and communication time. We analyze the execution time of the system task to obtain the performance formula of the system.The main factors affecting system performance is shown in Table 1.

The communication time includes three parts, which are independent of each other. We need to set the interval between the transmission time each time, and then combine the buffer to improve the transmission efficiency. The values are as follows:

$$p_s \leq \frac{II_s * B}{f_s * b}$$

5

The data calculation time of the i-th layer neural network is:

$$t_i = Delay + \left(\lceil \frac{v_i}{p_s} \rceil * h_i - 1 \right) * \frac{1}{f_s}$$

6

It can be approximately expressed as:

$$t_i \approx \frac{v_i}{p_s} * h_i * \frac{1}{f_s}$$

7

The calculation time for the entire sample can be calculated as:

$$T_s = N * \left(\frac{\sum_{i=1}^{L} v_i * h_i}{p_s} \right) * \frac{1}{f_s}$$

8

The system time calculation formula is:

$$T_s = \frac{N * O * t\left(f_s\right)}{p_s}$$

9

We have summarized the power consumption resources of FPGA, Table 2 shows DIL system calculates FPGA power consumption and resource utilization. Table 3 shows a summary table of the power consumption resources of the system. Because we use chip technology and use multiple FPGAs for calculations, the number of resources consumed by the entire system is much higher than that of a single FPGA.

3.4. Multi-FPGA acceleration system performance model

The process of verifying the performance model of the system is shown in Fig. 6.

If the number of layers of the neural network is more than the number of FPGAs, we need to calculate the neural network layer by layer, starting from the first layer and continuing to iterate down. After the calculation of the data of each layer is completed, the calculation of the next layer is performed until the calculation is completed, and the result is sent back to the background.

In summary, the value range is:

$$\mathrm{p_p} \leq \frac{\mathrm{II_s}*\mathrm{B}}{\mathrm{f_p}*\mathrm{b}}$$

10

We need to divide a plan for each layer, and we can expand the multilayer neural network on multiple FPGAs to perform multiple stacking calculations. If the depth of the neural network is less than the number of nodes, then each FPGA can be responsible for the calculation of each layer of the neural network. This is a simple multi-task pipeline calculation process, and the calculation formula is:

$$\mathrm{T_{DBL}} = \sum_{\mathrm{i}=1}^{\mathrm{F}} \mathrm{t}(\mathrm{F_i}) + (\mathrm{N}-1)*\mathrm{II_m}/\mathrm{f_p}$$

11

The approximate calculation formula is:

$$\mathrm{t}\left(\mathrm{F_i}\right) \approx \frac{\mathrm{o_i}*\mathrm{t}\left(\mathrm{f_p}\right)}{\mathrm{p_p}} \ \mathrm{i} = 2\ 4\ \ \ldots \mathrm{L}$$

12

The single-task calculation time of a group of FPGAs is:

$$\mathrm{t}\left(\mathrm{F_{i-1}}\right) + \mathrm{t}\left(\mathrm{F_i}\right) \approx \left(\frac{\mathrm{v_{i-1}}}{\mathrm{p_p}} + \frac{\mathrm{o_i}}{\mathrm{p_p}}\right)*\mathrm{t}\left(\mathrm{f_p}\right)\ \ \mathrm{i} = 2\ 4\ \ \cdots\ \ \mathrm{L}$$

13

$$t\left(F_{i-1}\right)+t\left(F_{i}\right)\approx\frac{o_{i}*t\left(f_{p}\right)}{p_{p}}\ i=2\ 4\ \ \ldots L$$

14

The working time calculation process for a single task is:

$$\sum_{i=1}^{F}t(F_{i})=\frac{o_{\frac{1}{2}}}{p_{p}}*t\left(f_{p}\right)$$

15

The process of calculating the calculation time of a certain section of the pipeline is as follows:

$$II_{m}=\frac{O_{max}}{p_{p}}$$

16

Substitution:

$$T_{DBL}\approx\left[O_{\frac{1}{2}}+(N+1)*O_{max}\right]*t\left(f_{p}\right)/p_{p}$$

17

After being divided by layer, its performance is:

$$S_{DBL}=\frac{T_{s}}{T_{DBL}}\approx\frac{N*O}{O_{\frac{1}{2}}+(N+1)*O_{max}}*\frac{p_{p}}{p_{s}}*\frac{f_{p}}{f_{s}}$$

18

The throughput rate of the system is as follows:

$$TP_{DBL}=\frac{N*O}{T_{DBL}}\approx\frac{N*O*f_{p}*p_{p}}{O_{\frac{1}{2}}+(N+1)*O_{max}}$$

19

We use the pipeline calculation method. When the calculation time in each FPGA is different, we calculate according to the longest time, which is also the bottleneck of FPGA. In the process of waiting, many FPGAs have free time and have not maximized their efficiency. Therefore, we also need to consider further improving the performance of the system and utilize the free time of FPGAs.

4. Application Of Public Health Safety Laws Based On 5g Smart Technology

4.1. The development of artificial intelligence in the 5G era

With the modernization of society, artificial intelligence technology has gradually developed and been applied in various industries, bringing new changes to the progress and development of the industry. In particular, it has a positive impact on the improvement of labor efficiency, and also provides a richer material and spiritual enjoyment for all aspects of people's lives. By integrating and supplementing 5G technology and artificial intelligence technology to a certain extent, it can play a certain beneficial role in the realization of information transformation. The continuous development of communication technology has realized more efficient information exchange and transmission, and the emergence of 5G technology has further promoted the Internet of everything. Based on the development of comprehensive industrial automation, social productivity continues to improve, freeing people's hands at the same time from a variety of aspects to meet people's spiritual world. 5G technology not only accelerates the development process of communication industry and manufacturing industry, but also promotes the development of entertainment industry, which is more prominent in the film and television industry. 5G technology promotes the development of society and economy, and also implements the people-oriented characteristics of my country's economic development.

Through the integration of artificial intelligence technology and 5G technology, it will greatly promote the development of artificial intelligence technology, and there will be new breakthroughs in the future social lifestyle. In terms of the construction of smart city system and smart living system, with the continuous progress and promotion of 5G technology, the technological level and business content of the Internet of Things may have a qualitative leap. It has shown that the robots we designed can already achieve higher precision and accuracy than humans in terms of calculation and simulation. In engineering and manufacturing, the application of artificial intelligence technology also plays a positive role, which can greatly reduce people's work pressure and provide more scientific solutions to problems. The application of 5G technology to the field of artificial intelligence can greatly improve the computing speed of artificial intelligence, especially the data processing of contemporary cloud big data has a significant promotion effect.

4.2. The reason why the government undertakes to maintain public health safety

The government is the core of society and has made contributions to society. Government personnel are always faced with events that may occur in society at any time, and they are tested and resolved. At the beginning of the 21st century, an epidemic broke out in a certain area, and the number of patients and deaths had reached a peak. At the beginning, people's focus was only on some individual patients, and later on a certain family, and finally people turned their perspectives on the issue of public health and safety. Under such circumstances, the whole society pays great attention to the government, and the pressure on the government has become very heavy. If we want to completely solve the problem of public safety, we need not only rely on medical technology, but also need the government to adjust it. The reason why the issue of public safety is so important is that it will affect the health of a large number of people, and may even affect the stability of the entire society. The social impact of public safety issues is very far-reaching, and once it occurs, the impact is very bad. If the government chooses the end of the

world or ignores it at this time, it may lead to economic recession and even threaten national security. Under such conditions, the government must firmly grasp its dominant position, maintain public order, protect people's health and property safety, and provide stable living conditions.

4.3. The main problems of the government in the construction of public health safety legal system

When some sudden public health security incidents occur, the government must actively organize the masses to prevent the incident and actively carry out emergency response measures. This problem can only be solved by the government. This is also the basic responsibility of the government and a manifestation of the government's dominant position. For some NGOs, they are not the mainstream status of the society. Although they will often provide some assistance to participate in some rescue activities, some NGOs are not mature enough, and the bureaucratic atmosphere in some organizations is very strong, even with There are some religious colors. When some emergencies occur, these unofficial organizations lack flexibility and organization, and their credibility and influence are insufficient, and it is difficult to be trusted by people. Therefore, in the event of an emergency health incident, the government must assume the main responsibility, which is also the government's function and responsibility.

4.4. The soundness of the public health safety legal system based on the government's perspective

In the face of some emergency health incidents, a country’s legislation plays a very important role. The legislation of a country not only guarantees that government departments can exercise their power and exert their dominant position to organize in the event of emergencies. On the other hand, the ability of a country to actively formulate measures to deal with emergencies also shows that the country attaches importance to the law and has perfected the construction of the rule of law. Some developed countries in the West attach great importance to this aspect of construction, and have also invested a lot of funds and manpower to maintain legalization.

In the process of law enforcement, for a certain area, a special prevention and control agency should be established in the area, and the government should give this agency the necessary rights to work with the government to coordinate and orderly complete rescue and organization activities. At the same time, regional prevention and control agencies and organizations must strictly abide by the law. In the face of emergencies, once deserters or illegal personnel appear, they should also be punished in accordance with the law. In the event of some critical situation, the government should protect the safety and rights of citizens to the utmost extent. The administrative organs of the country are not only responsible for managing the affairs of the country, but also concerned with public safety and the interests of citizens.

China's socialist market economy is in the process of continuous development, the judicial structure is relatively perfect. At present, Chinese people have very high expectations and requirements for judicial justice, and the social level has also put forward high requirements for judicial justice. The state delegates judicial power to judicial organs, and judicial organs exercise their judicial powers in

accordance with the law. When facing actual cases, judicial power must maintain its independence in order to ensure its fairness and legitimacy. If we want to reform the judicial system, we must guarantee the independence of the judicial system. In the face of some sudden public safety incidents, social stability and citizens' property safety will be threatened. Judicial agencies must be able to stand up to ensure social fairness and justice, and adhere to the concept of rule of law until citizens establish fairness and justice. Judicial activities can regulate right and wrong, crack down on illegal and criminal acts, and can also protect people's legitimate rights and interests and maintain social fairness and justice.

5. Conclusion

The development and application of 5G technology and artificial intelligence technology have brought a lot of convenience to social life and played an important role in promoting social development. As a researcher in the field of 5G technology, continuous and in-depth exploration and research are needed for the dual technology integration of 5G technology and artificial intelligence technology, relevant personnel should also discuss the future development model and development direction of the two, and apply the products of the integration to all aspects of people's lives to realize intelligent life and intelligent home. Public safety has received widespread attention from all over the world, and people have begun to pay more and more attention to public safety issues in various regions. Each region should learn from the successful experience of public health incidents in developed countries, establish a response system and launch response policies based on the characteristics of the region. This is also a concrete manifestation of the government's performance of its functions.

Declarations

Compliance with Ethical Standards

Conflict of interest

The authors declare that they have no conflict of interests

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Data Availability

Data will be made available on request.

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Tables

Table 1 DLAU acceleration system performance parameter table

Parameter category		Parameter symbol	Parameter meaning
Parameters of the network structure		N	Sample size
		L	The depth of the network
		v_i	Number of display elements in RBM
		h_L	Number of hidden elements in RBM
System parameters	Parameters of the transmission process	B	Storage bandwidth
		b	Operand bit width
	Parameters of the calculation process	t_a	Time required for floating point addition
		t_m	Time required for floating point multiplication
		t_s	Calculation time required for the activation function
		II_s	Pipeline interval
		f_s	Frequency (Hz)
	Parallel process parameters	p_s	Shard size

Table 2 DIL system calculates FPGA power consumption and resource utilization

On-Chip Resources	Power (W)	Used	Av artificial intelligence label	Utilization (%)
Clocks	0.043	3.0	—	—
Flip Flop	0.001	9831	106410	9.20
LUT	0.022	12833	53202	24.30
Signals	0.033	31174	—	—
BRAM_18K	0.001	18.0	141	12.84
DSP48E	0.020	87.0	222	39.55
PS7	1.527	1.00	—	—
Static Power	0.160	—	—	—
Total	1.815	—	—	—

Table 3 DI system controls FPGA power consumption and resource utilization

On-Chip Resources	Power (W)	Used	Av artificial intelligence label	Utilization (%)
Clocks	0.036	7.00	—	—
Flip Flop	0.011	782	607210	0.132
LUT	0.005	7222	303601	2.360
Signals	0.005	134856	—	—
BRAM_18K	7.00	18.0	1031	0.660
DSP48E	0.001	6.00	2802	0.210
Static Power	0.242	—	—	—
Total	0.418	—	—	—

Figures

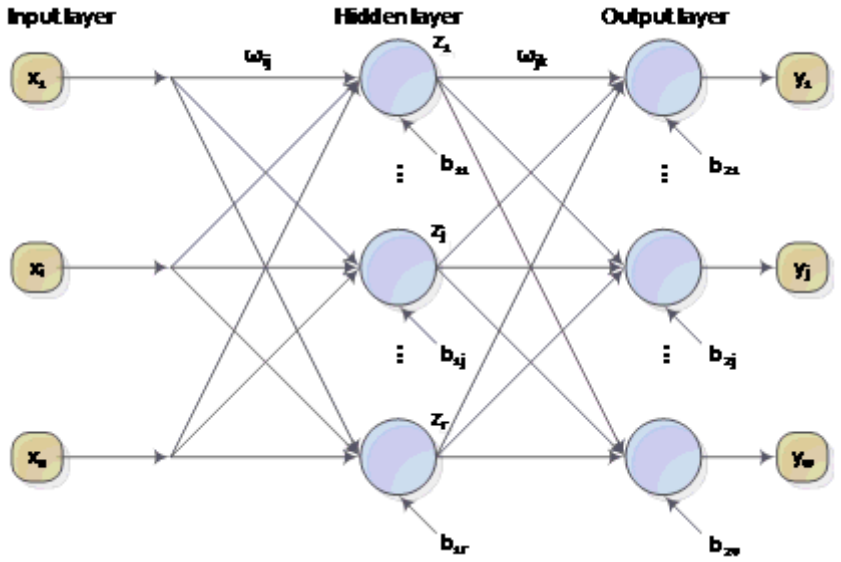

Figure 1

neural network

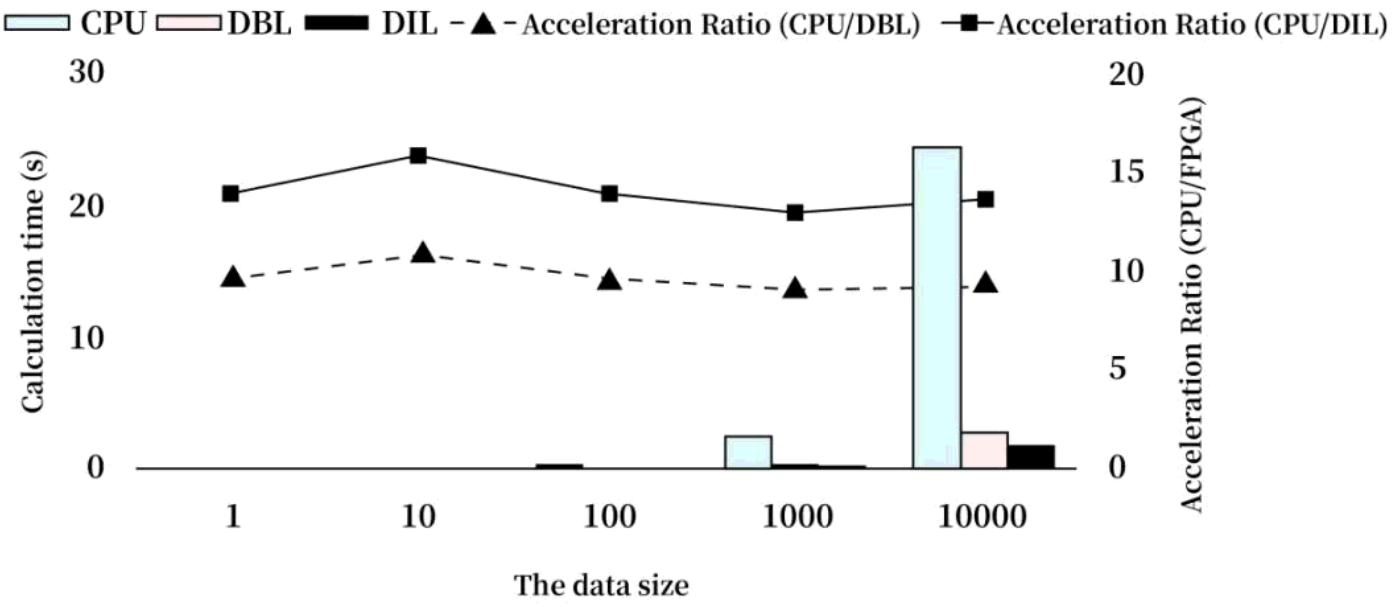

Figure 2

The relationship between data scale and system performance in FPGA system

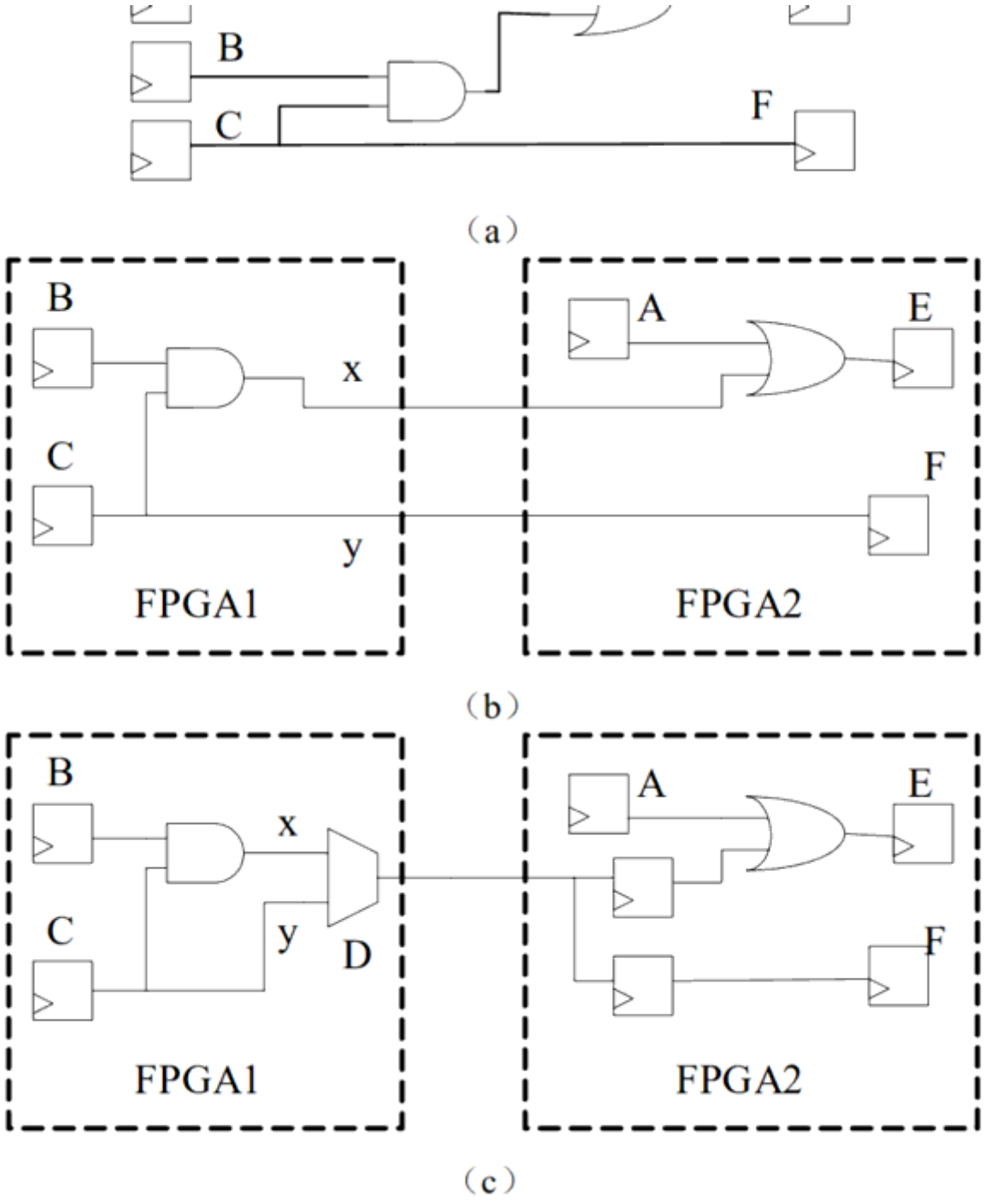

Figure 3

Logical division and mapping of simple circuits

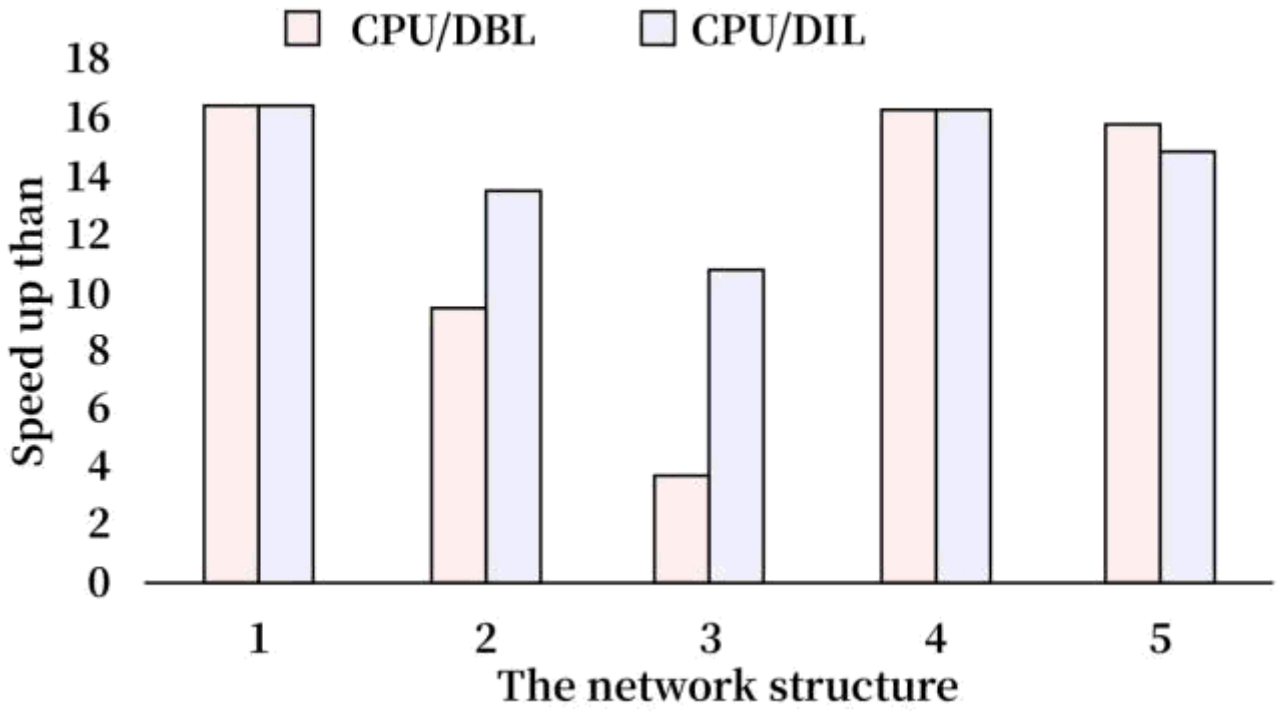

Figure 4

system performance in FPGA system

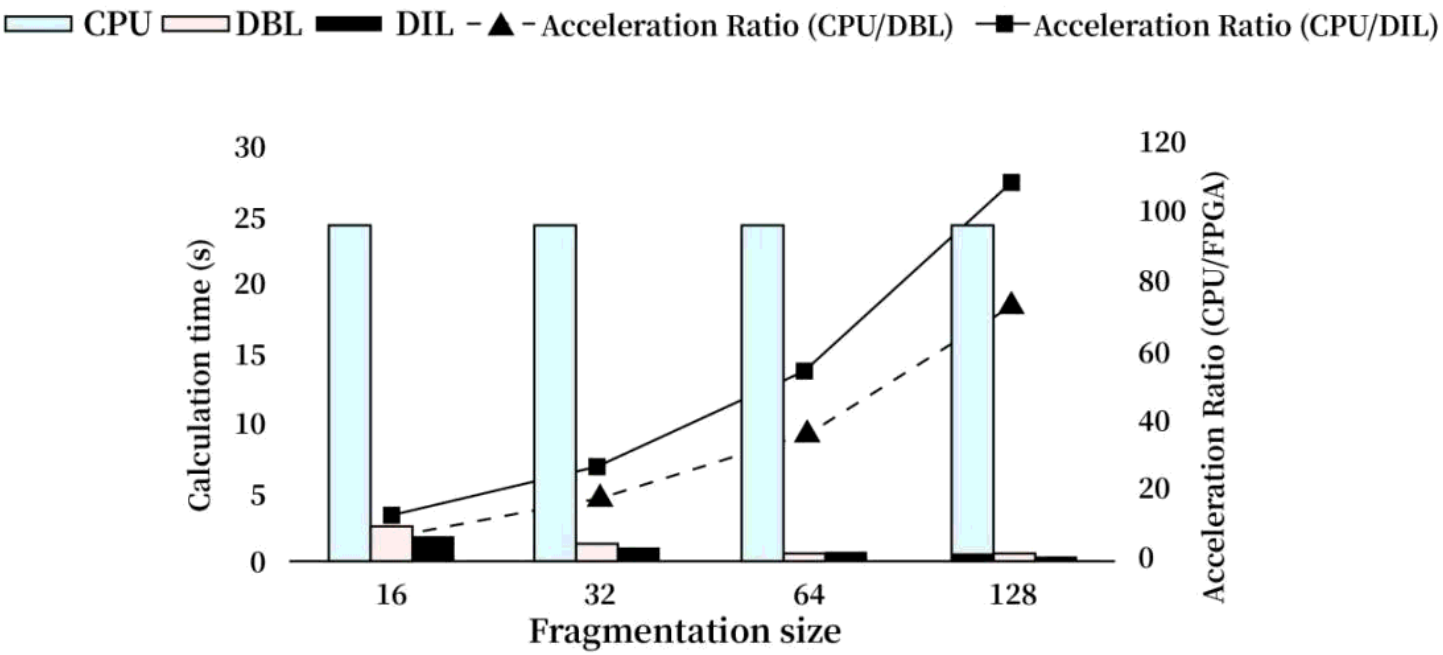

Figure 5

Relation diagram between slice size and system performance in FPGA system

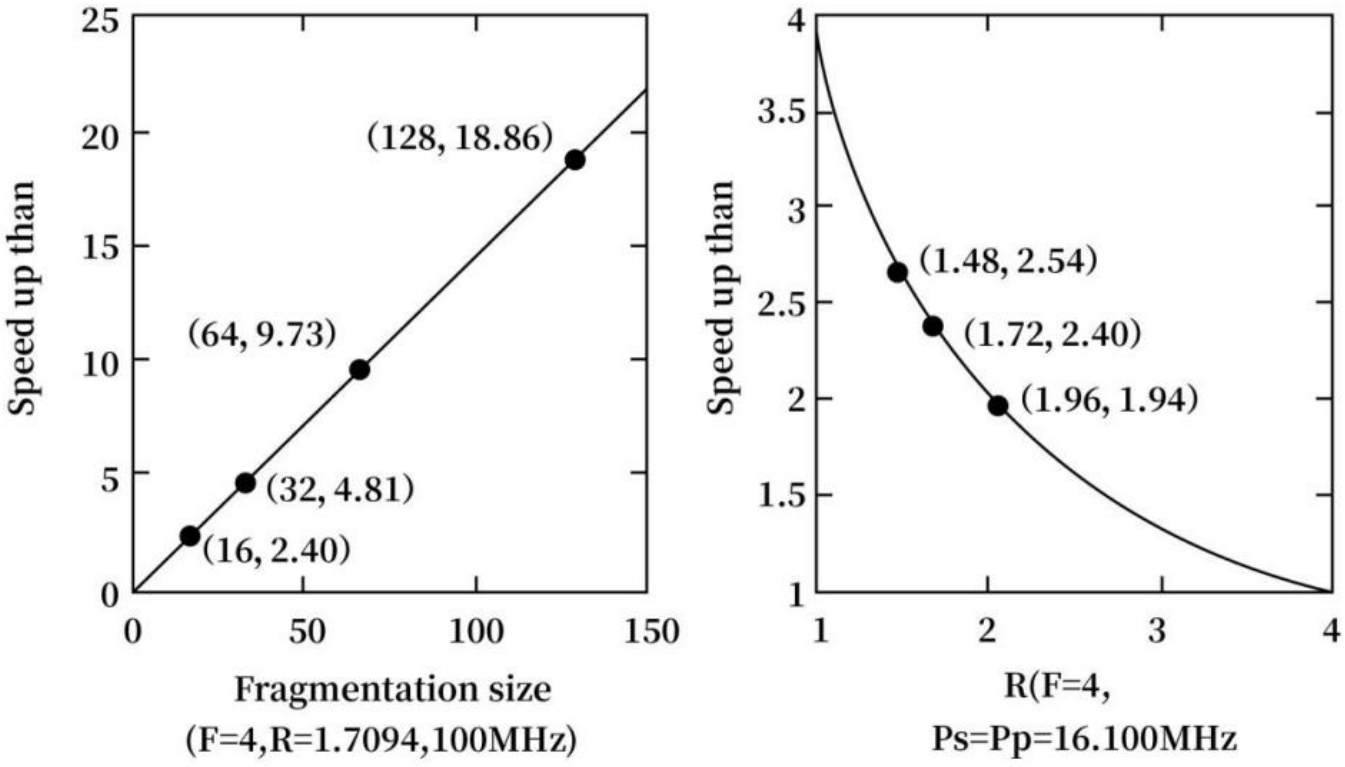

Figure 6

DBL system performance model parameter verification