The status and development of industrial robots

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Abstract. The status quo of industrial robots mainly discusses the application technologies involved in the research of robots at the current stage, which effectively demonstrates the relevant applications of industrial robots in the field of smart manufacturing. However, the development of the application technology of industrial robots has not received enough attention. This is also the main reason that causes the disconnection between the design and manufacturing of industrial robots and the application requirements. This not only limits the popularity of industrial robots to a great extent, but also limits the large-scale and vigorous development of the industrial robot industry itself. This article aims at some actual conditions of the existing industrial robots in manufacturing automation applications, and systematically summarizes and analyzes the future research direction and strategic thinking of industrial robots. In this era of the rise of the industrial Internet, this article also discusses some possibilities for industrial robots to integrate with it. Effectively grasping the relevant principles and implementing research and development of related technologies have significant significance for improving the overall level of China's industrial robots and accelerating the pace of manufacturing to intelligent upgrades.

1. Industrial Robots Overview

The concept of industrial robot was first proposed by the United States in 1960. It can be programmed to make the machine perform the corresponding work, and it can also change the program to complete a variety of work. The world's first robot was designed and developed by George Charles Dovel. In 1969, Victor Scheinman invented the all-electric six-axis articulated robot --- "Stanford manipulator." At present, the world's four largest industrial robot companies are KUKA (Germany), ABB (Sweden), FANUC (Japan), and Yaskawa Electric (Japan), and the sum of their sales volume of industrial robots accounts for half of the total market. In addition, China Xinsong Robot Automation Co., Ltd. is also an important supplier of international industrial robots. According to the forecast of IFR in its 2015 statistics report "World Robotics 2015", the sales volume of industrial robots in the world from 2016 to 2018 will grow at an average annual rate of about 15%, and Asia will occupy 18% of them. Global sales this year are expected to reach 405,100 units. The scope of application of industrial robots has continued to expand and the work completed has become increasingly complex. In addition to being able to replace workers for tedious and complicated work such as assembly, grinding, welding, and packaging, it is also mainly used in automobile manufacturing, metal forming, plastics industry, electronic and electrical, and chemical industries.

2. Main background

Since the beginning of the 21st century, with the continuous improvement of the degree of automation, robots have become an increasingly popular research direction, followed by more applications and

upgrades. Domestic and international attention has been paid to the development of robotics technology. Countries around the world have put forward their own development plans.

2.1 The plan of China---Made in China 2025

2.1.1 Existing conditions

In 2012, the proportion of China's manufacturing industry has been comparable to that of the United States. China has a huge market and domestic demand is the biggest driving force. China has the world's most complete and independent manufacturing system.

2.1.2 Strategic deployment

China is a big country with manufacturing industry but not a manufacturing power. Manufacturing industry is the foundation of rejuvenating the country. Changing its status quo that is not strong enough is not only important but also urgent for China's current economic development. Premier Li Keqiang stated in the government report that it is necessary to implement "Made in China 2025" to accelerate the shift from manufacturing to a manufacturing power. On May 8, 2015, the State Council issued the "Made in China 2025" deployment to comprehensively advance the strategy of implementing a manufacturing powerhouse.

Three stages in the process of China's manufacturing power can be listed as below：

(1) In 2025, China’s manufacturing industry can enter the world’s second square, getting into the ranks of manufacturing power.

(2) In 2035, China’s manufacturing industry will be the second largest square and become a veritable manufacturing power.

(3) In 2045, China’s manufacturing industry will be expected to enter the world’s first square, becoming a global leading influential manufacturing power.

2.1.3 Guiding ideology

The introductive ideas of “Made in China 2025” ： Innovative development, improve quality and efficiency.

Innovation is the source of manufacturing progress while it is also a huge driving force for iterative upgrading. The close integration of production, education, and research is an effective measure, which can be based on innovation and development in specific fields, and the development of a number of innovation centers to study manufacturing bases and key technologies, and at the same time, coordinate the industrialization of research results and personnel training. Train talent to build a well-established manufacturing research group.

Quality can reflect the level of a country's manufacturing industry. It is necessary to improve the quality of low-cost competition to high-quality competition, reduce or even eliminate the phenomenon of crude construction.

2.1.4 Intelligent Manufacturing

Smart manufacturing accelerates the integration of information technology and traditional manufacturing industries. Industrial robots play an important role in this process. New information technologies such as the Internet of Things, cloud computing, and big data complete breakthroughs, making information transmission faster and cheaper. The development of smart devices - intelligent industrial robots, which have the ability to sense, connect, and analyse, partially replace human mental labor in manufacturing, and comprehensively increase the level of manufacturing. Intelligent industrial robots can use digital control and network information to improve accuracy, quality, and efficiency.

2.2 Foreign plans

2.2.1 Germany

Germany has strong equipment and workshops, and it has a very high standard in the field of information technology. At the same time, it also has strong technology in automation engineering. The German Workers-4.0 aims to create a smart factory to achieve the purpose of smart production, and then maximize the supply efficiency through smart logistics. To make use of CPS (information physics system) to achieve the transition from centralized control to decentralized control to promote the current manufacturing industry to improve in the direction of intelligence, the industrial chain division of labor is also facing restructuring. CPS is a manufacturing system that combines computer networks and multidimensional and complex systems in the physical environment through 3C (computation, communication, control) technology.

2.2.2. The United States

In 2011, U.S. President Barack Obama announced the implementation of the "Advanced Manufacturing Partnership Plan" including industrial robots and immediately received a positive response from the new report "Realizing 21st Century Smart Manufacturing" released on the same day. [1] In 2011, the United States launched the National Robotics Initiative (NRI). In 2016, the National Robotics Initiative 2.0 (NRI-2.0) was launched. NRI-2.0 emphasizes scalability and Connectivity.

3. The status of industrial robots

3.1 Domestic status

Chinese industrial robots began formal research work in the early 1970s. Due to the slow development of the economic constraints at the initial stage, industrial robot technology has been greatly supported under the policies of the “7th Five-Year”, “Eighth Five-Year Plan” and “Ninth Five-Year Plan” development plans while the research results have been widely used. In the research of industrial robots, many domestic universities and research institutes, such as the Institute of Automation of the Chinese Academy of Sciences, Tsinghua University, Beijing University of Aeronautics and Astronautics, Shanghai Jiao tong University, South China University of Technology, and Hunan University, have conducted a lot of research work in driving and controlling. Achievements have been made in such areas, which have laid a solid foundation for China's robotics research and industrial development. The market of domestic industrial robots has been continuously expanding. Shenyang Xinsong Robot Automation Co., Ltd., Guangzhou CNC Equipment Co., Ltd. and other companies have also achieved good results in the industrial robot industry. The development of industrial robots in China is on the right track. Nowadays, in basic research, China has basically mastered key technologies; in terms of control, the main computer is being upgraded.

Despite the development of our country’s employment industry driven by international cooperation, the dependence on core components is still relatively large.

3.2 Foreign status

The United States, needless to say, is the birthplace of robots where industrial robot technology has formed a scale. With large-scale procurement of host and supporting equipment’s redesigning, researching, development and debugging, the United States has owned many companies with international influence.

Japan introduced the technology of the United States and made rapid development. In 1968, the first Japanese robot was developed. In the mid-1980s, the world’s advanced industrial robots were nearly 60% in the world, far surpassing the United States, and were “kingdoms of robots”. Through the division of labor in the industrial chain, Japanese companies are moving toward the development of new industrial robots and mass production. For example, today's products are the world's first in production, export, and use.

Europe adopts a system integration solution for users. The industrial robot manufacturer undertakes and completes the industrial robot manufacturer's responsibility for the design and integration of industrial machine production and application processes. [2] Europe has achieved complete autonomy

of its core components and is a leader in industrial robots. The emphasis on technology research and development and industrial upgrading combined with the "German Industry 4.0", industrial robots ushered in opportunities for development.

In the international arena, the fourth industrial revolution will start - a wave of "re-industrialization."

3.3 The challenges that China encounters

(1) Due to the limitation of core parts, domestic industrial robots cannot be mass-produced and rely heavily on imports.

(2) Basic research is at a high level, but there is less research on the application side.

(3) The core technology did not break through and is subject to people. Therefore, there is no independent intellectual property, and no independent brand.

(4) The domestic industrial robot market is monopolized by foreign companies, and foreign companies are striving to open up markets in China.

4. The development of industrial robots

4.1 Industrial Internet

Industrial Internet is the result of the integration of global industrial systems with advanced computing, analysis, sensing technology, and Internet connectivity. It connects the intelligent machines and eventually connects humans and computers, combines software and big data analysis, reconstructs global industries, and stimulates productivity. In recent years, with the integration of the global economy, countries around the world have stepped up their investment in high technology. The rise of emerging technologies such as artificial intelligence is bringing new changes to the industry. In the manufacturing industry, AI represented by industrial robots is gradually becoming one of the core computing frameworks of the Industrial Internet. To fully realize the industrial Internet, intelligent manufacturing is a necessary link, and artificial intelligence is a prerequisite for this link.

According to the study, there are definite opportunities in the areas of solution provider and intelligent manufacturing equipment supply in the industrial Internet industry chain enterprises. From the perspective of the development status of China's industrial robot industry, some well-known leading companies and many robot companies are actively deploying system integration services such as smart manufacturing.

A few days ago, a well-known robot company announced that it will cooperate with Huawei Cloud to deploy the Industrial Internet. Based on a wide range of industrial customers and a large number of industrial site deposition equipment and accumulated a wealth of process parameters and production experience, you can build the industrial Internet platform to achieve the integration of the underlying data and reuse of industrial knowledge.

4.2 The main direction of development

Industrial robotics technology is mainly moving toward intelligence. Continuous development of the manufacturing industry and constant breakthroughs in technology have made it more and more desirable for industrial robots. In order to achieve human-machine coordination, the development direction of industrial robot technology is mainly:

(1) Intelligent. Mathematical modelling and algorithm optimization for realistic problems are no longer sufficient. Artificial intelligence is just as exciting and can be applied to the "smart growth" of industrial robots.

(2) Improve flexible work ability. Industrial robots have been able to substitute workers for some of the lower levels of work. But still cannot complete some complex and sophisticated work. Increasing the load/weight ratio, bulk materials, etc. can better solve this problem.

(3) Human-computer interaction. At present, the interaction with industrial robots is mainly achieved through the use of touchpads, remote controls, and the like. Study the interactive problems of low friendliness and low intelligence through interactive methods such as gestures and voices. [3]

When working with humans, intelligent industrial robots not only understand what it should do, but also understand what people are doing. In addition, it is also possible to predict what humans will do next and think. There will be communication between multiple robots, and the overall perception ability will be stronger. To achieve sharing, the Internet can also plan and coordinate actions together. Technological problems such as scalability and physical security need to be broken.

In fact, the business model is very important to the manufacturing industry. In the future, the business model of the future manufacturing industry will be to solve customer problems. So, in the future, manufacturing companies will not only sell hardware—physical transactions, but also follow-up services to gain more added value. The "soft matter" with information transfer function becomes the new core of hardware products, which means personalized demand, and private customized manufacturing will become the trend. In the manufacturing process, we will increase the added value of products as much as possible, expand more services, and propose more superior solutions to meet the individual needs of consumers.

We still find it difficult to see the shadow of intelligent robots in our lives now. In the near future, however, with the continuous development and maturation of intelligent robot technology, perhaps we can change the status quo. With the unremitting efforts of numerous scientific researchers, intelligent robots will surely enter millions of households which will serve people's lives better and make people's lives more comfortable and healthy. [4]

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