

Research Status and Development Trends of Industrial Robot

Shengjun Ji^{1,2,3}, Zhiyu Liu^{1,2,3}, Liang Zhang^{1,2,3,*}, Jiaan Cao^{1,2,3}, Jiahui Zhu^{1,2,3},
Yongquan Zhao^{1,2,3}

¹College of Mechanical and Electronic Engineering, Hebei Normal University of Science and Technology, Qinhuangdao 066600, China;

²Hebei Technology Innovation Center of Photovoltaic Module Manufacturing Equipment, Qinhuangdao 066600, China;

³Hebei Engineering Research Center of PV Module Encapsulating and Measuring Equipment, Qinhuangdao 066600, China.

*zhangliang2005@126.com

Abstract

With the rapid development of modern technology, some traditional production processes are gradually replaced by continuous innovation robots. In the future, robot development has great potential. This paper mainly studies Industrial robot problem for the research status, development trend and application, at the same time, some opinions are proposed.

Keywords

Robot; Research Status; Application; Development Trend.

1. Introduction

The robot is a typical highly automated and intelligent mechanical-electrical integration equipment. It can complete the target operation through the specific trajectory of computer programming or automatic simulation of human action, which has high reliability, flexibility, large information storage, rapid problem handling and reaction capacity. Currently, robots have been widely used in various fields such as industry, agriculture, military, life, entertainment, and medical treatment.

As a type of robots, industrial robots are the embodiment of multidisciplinary advanced technologies integration of industry, electronics, computers and automatic control in industrial production. By searching and analyzing the data of the past five years, it is found that the development of robots has great space and potential. With the efforts of researchers, the defects of industrial robots will be compensated and finally complete automation will be realized in the future.

2. Domestic and Foreign Research Status

2.1 Foreign Research Status

American George Devol designed an industrial robot that can be used for programming in 1954 [1], which is the first generation of industrial robots. From then on, the industrial robots began to go to the world. In the 1980s, due to the rapid development of world industrial production technology towards a high degree of automation and integration, it promoted the development of industrial robots. The foreign research on robots seems relatively early and its development proves also more than fast, the industrial robots technology has gradually become mature. Currently, Japan is the world leader in both the number and the output of robots, and it has become the kingdom of robots. In the mid-1990s, industrial robotics in Europe and North America grew stronger. With the rapid development of

science and technology, robots are gradually standardized, modular and intelligent, which plays an important role in the manufacturing industry and production process. At present, the well-known foreign industrial robot companies include Yaskawa, OTC, FANUC, Panasonic and Kawasaki, and other companies in Japan, ABB in Europe, KUKA and CLOOS in Germany, and Italy's COMAU, and Austria's IGM, etc. For nearly half a century, the use of industrial robots and the popularization of industrial robots are considered to be an effective means to rapidly improve productivity, achieve fully automated production, and promote corporate and social productivity in many countries..

2.2 Domestic Research Status

Research on robot in China started relatively late, but progress is relatively rapid, and it has made achievements in some areas, such as industrial robots, intelligent robots and special robots. Innovative technology [2] have been gained national support since the "Seventh Five-Year Plan" in the 1980s. Speaking for now, we have basically understood and mastered the design and manufacturing technology of industrial robots, hardware and software design kinematics of control system, etc, in the meanwhile, we have produced some key parts, created industrial robots, such as, painting, arc welding, spot welding, assembly. However, there is still a certain gap compared with other countries. Consequently, to develop industrial robots in a long and stable manner, we are supposed to select the essence and discard the dross of foreign industrial robots, learn experiences, which can develop industrial robots faster[3].

3. Application Fields of Industrial Robots

3.1 Industrial Manufacturing Field

Nowadays robots are mainly used in manufacturing and processing products, mainly in automobile manufacturing, replacing manual work in high temperature, toxic, or harsh working environments such as stamping, painting, welding, and heat treatment. For example, there will be a lot of dust in paper mills and more oily substances in the factory. Likewise, manufacturing environment of automobile, ship and household products, and in the chemical industry, there are spot welding, painting, cutting, electronic assembly and logistics handling, packaging, etc. [4]

3.2 Military Field

With the continuous development and innovation of high technology, to meet the needs of military science and technology, robots have gradually entered the military field since the 21st century, which has greatly improved our national defense capabilities. For example, when investigating the enemy, drones are used for detection to reduce casualties, and exploring every corner in more detail. When time bombs are encountered, robots can be used to remove them to reducing casualties, at the same time, robots will be more accurate, with a higher success rate than humans. Besides, robots can also combat reconnaissance, anti-tank, anti-helicopter, contamination decontamination, blasting attack, material shipment to rescue war-wounded vehicles, mine-laying and mine clearance, etc.

3.3 Agriculture Field

New agricultural production models are constantly being innovated, agricultural mechanization is becoming more and more widespread. With the gradual improvement of agricultural robots, agricultural costs are reduced, efficiency is improved, and production is increased. For example, picking robots can replace manual fruit picking, which can shorten time, manpower, financial resources, etc. Especially, picking robots in the hot summer prove more important. Besides, there are also grafting robots grafting some tall and tall fruit trees, reducing the risk of personnel. The pesticide spraying robot is more efficient than farmers, and it will never harm the body of farmers. In addition, planting robots, weeding robots, and other robots.

3.4 Entertainment Field

With the improvement and progress of robots, it is the entertainment field that industrial robots have added, such as, smart robots often seen in shopping malls, food delivery robots seen in restaurants, or robot competitions, robots playing piano, robots that help children learn, etc.

3.5 Medical Field

In the medical field, the requirements for robots are particularly strict. These robots can help doctors perform operations like foreskin surgery, stomach surgery, eye surgery, brain surgery, etc. [5] Foreign countries have also invented a miniature that can enter human blood vessels to kill viruses. Moreover, there are also robots that help nurses complete some simple tasks, such as, testing the air quality in the room.

4. Development Trend of Industrial Robot

4.1 Mechatronics

"Edit controller-sensor-power element" is the main structure of the robot. The robot senses objects and the surrounding environment with the help of sensors, and then feeds back the monitored information to the control system. The control system analyzes the information to make adjustment commands, which make the execution system reach the corresponding position more accurately. Therefore, the combination of mechatronics and robot can make the robot more adaptive to the environment, and has certain action independence, at the same time, expand the application range of the robot, which will become the future development trend of robots.

4.2 Autonomous maintenance

Robots often encounter some faults in their work. Employees need to check the robot and detect it by elimination method, and find the fault for maintenance. During maintenance, personnel may also be injured, it not only damage the products produced, but also consumes time and energy. At present, some robots can perform simple self-maintenance. With the rapid development of maintenance robot, the robot will sense through the sensor, and feed back to the control system to quickly stop working by performing self-power-off when the robot break down. In the meanwhile, Information will be also fed back to the maintenance control system. The maintenance sensor will quickly detect robot failures, and feed the information back to the control system, which will make robots realize self-repair. For non-repairable faults, the robot displays the fault questions and reasons on the screen to make employees replace it easily. Therefore, the autonomous maintenance robot solves the difficulties in the work and has great development prospects.

4.3 Multi-function, high reliability, wide application

Today's robots can only perform a single task, such as, fruit picking robots. Although some picking robots have achieved the versatility of picking fruits, they can only be used to pick fruits and cannot perform diverse activities like humans. Moreover, robots often go wrong. In the future, the robot will develop into a multi-functional and highly reliable machine. The robot can perform various tasks just like human beings, such as picking fruits, picking cotton, fertilizing, and doing housework, etc.. The use of cost-effective materials will improve the reliability of the robot, reduce the occurrence of failures, which will make the robot widely be used.

4.4 High efficiency and energy saving

No matter how fast the robot develops, we must conform to the requirements of the times to save resources and protect the environment. Energy saving is a topic that people have been chasing since the 21st century. Many industries have developed non-lubricating components without grease, such as bioengineering, medicine, food, electronics and other industries that meet pollution-free requirements. In recent years, new materials have been continuously researched and developed. However, today's industrial robots still have the disadvantages of heavy machinery, large size, and high power consumption. In order to follow the principle of energy saving, industrial The robot is

constantly developing in the direction of high efficiency and energy saving, gradually making the robot a petite, lightweight, flexible, energy-efficient robot with low power consumption and low economic cost.

4.5 Repeat accuracy

In the manufacturing and processing industries, industrial robots repeatedly perform a task, but in the repeated process of the robot, it is difficult for the robot's motion accuracy to reach the original position, causing some errors. However, in actual work, every action must be accurate to ensure the quality of the product. Especially in the military and medical fields, the accuracy requirements for robots need to be higher. For example, mine removal will explode if there is a slight error, so repeat accuracy robots are the inevitable trend of future development [6].

4.6 Speed-up

In the industrial production and manufacturing industries, the robot takes a lot of time from grabbing an object to placing it at the destination, so the speed of the robot determines the work efficiency. For example, the loading and unloading robot sucks the glass through a vacuum, and then moves to arrive. In this process, time occupies 90% of the entire process time. High work efficiency is not only the top priority of every enterprise, but also the goal pursued by the whole world. Therefore, the speed-up of robots in the future will be came true.

5. Summary

In the future, with the continuous innovation and development of robots, industrial robots will not only take part in military, agriculture, entertainment, medical, but also enter other fields to fully realized automation, to a large extent, which will reduce labor, improve work efficiency and reduce costs . And our country can become a first-class country of completely independent research and manufacturing on robots. It will realize mechanical-electrical integration and "cure" themselves like human beings, conforming to the requirements of the times, and realize the vision of energy saving and high efficiency, at the same time, the repetitive high-precision errors during work can almost be ignored. These are the goals of China's enterprise development and the trend of industrial development. I believe robots will be more dazzling and colorful in the future.

Acknowledgments

This work is supported by Major achievements transformation project in Hebei Province, Project number: 19014312Z, and Teaching case project in Hebei Normal University of science and technology in 2020, Project number: 2021AL02.

References

- [1] B.y. Han. On the development status and trends of industrial robots. Science and Technology Vision, (2017) No.11, p.47-48.
- [2] W. Liang, X. Xia. Research status and development trend of industrial robots, Information Recording Materials, Vol. 20 (2019) No.7, p.48-49.
- [3] P.Chen. Research status and development trend of industrial robots, Science and Technology Information, Vol. 17 (2019) No.4, p.60-61.
- [4] W.L.Dong. The application of robots in the field of automatic packaging, Chemical Management, (2020) No.9, p.145-146.
- [5] H.L.Zheng, Q.Pan. Analysis of the development trend and application of industrial robots, Science and Technology Wind, (2019) No.20, p.183.
- [6] X.Feng, M.X.Song, X.Y.Ni, L.Y Ma, , et al. Overview of the development of industrial robots, Science and Technology Innovation and Application, (2019) No.24, p. 52-54.