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Research on structural design and intelligent development of welding robots

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Abstract

As an important part of modern manufacturing processes, welding is a frequently used method in machining processes. When welding is carried out, the environment is often relatively harsh and the arc light generated during welding can be harmful to human eye health to a certain extent. In addition, welding work, different parts of the internal structure of the specificity of the differences in the structure of the complex and varied resulting in the traditional manual welding has not been able to adapt to the modern society of high-tech product manufacturing requirements, welding quality is difficult to get efficient guarantee. In the continuous development of society, the emergence and application of computer technology and automation control technology has facilitated the birth of welding robots, which are used in the manufacturing industry for the quality and efficiency of welding work has a positive effect and influence on the improvement of the working environment for workers to create good conditions. Therefore, this paper will focus on the study of welding robots, from the structural design and intelligent development of the two aspects of the introduction, in order to provide feasible suggestions for the relevant staff.

Keywords

Welding robot; structural design; intelligent development; application research.

1. Introduction

With the progress and development of science and technology, China's welding process has also begun to appear in a new mode, the traditional manual welding in the application of time due to the lack of innovation and innovation, has been difficult to meet the high standards and high requirements put forward by modern manufacturing construction, while the role and influence of electronic information technology, the emergence of welding robots but for the welding process to provide a new path for the automation and intelligent development of welding Provides the technical support. The use of welding robots for related operations can effectively improve the shortcomings of the traditional process, welding quality and efficiency have shown a steady upward trend, however, by the impact of the operating environment, coupled with the increasing difficulty of the task, industrial welding robots in daily use, flexibility is still lacking, especially in the timely identification and avoidance of obstacles in the operation, resulting in the task time is constantly This leads to extended task times. In response to this situation, in the process of innovation and transformation of welding robots, it is necessary to further strengthen the automation, intelligence and flexibility of the robot research, so that its application can be more in line with the requirements of modern manufacturing, to ensure the quality of welding.

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2. Structural design of the welding robot

For the manufacturing industry, when carrying out production activities, must involve the welding of products, and the quality of welding will directly affect the final use of the entire product, so in the manufacture of machinery, we must start from the details, welding work to ensure the quality of welding. With the continuous change and development of the times, the traditional form of manual welding has been difficult to meet the objective needs of manufacturing production, in the support of electronic information technology, automation and intelligent welding began to be widely concerned by society, the emergence of welding robots is to improve the quality and efficiency of welding to make a favorable guarantee. In the process of the practical application of welding robots, the first need to do a good job of structural design, so that it can play a stable role in the functionality, only then the entire welding work is to fall into place. From the actual production and application of welding robots, the common welding robots on the market can often contain the following types of structure: right-angle coordinate type, cylindrical coordinate type, ball coordinate type and chain coordinate type. In general, this type of welding robot is more flexible than the others in terms of flexibility and the spatial posture of the welding torch is also more than that of the right-angle coordinate robots when performing welding operations, which in To some extent, it can ensure all-round and multi-angle welding, and is often used in engineering projects with complex weld seam shapes [1].

A fully-articulated welding robot is usually composed of a mechanical arm, a welding power source and a control system. The mechanical arm mainly includes the base, rotary joints and oscillating joints, etc. The mechanical arm, which is one of the main components, is usually fixed on the base with the help of the spindle and can rotate around the spindle in actual operation, while the other end is effectively connected to the mechanical arm with the help of the joint grip. Through the interconnection between different joints, multiple mechanical arms can be connected with the mechanical arm in order to ensure the stable operation of the mechanical arm during operation. The outer end of the mechanical arm is often set up with a lifting shaft, which does not exist alone, but needs to be connected with the welding gun, and at the same time, each mechanical arm and the shaft should be set up with the corresponding control motor, these control motors are independent, in its role and influence, to achieve intelligent and automated operation of the mechanical arm. In the specific welding process, the welding robot control system is mainly to adjust and control the working state of each motor with the help of sensors, so as to drive each axis to rotate in an orderly manner, and to precisely control the mechanical large and small arms, and to carry out operations related to different forms of welds such as horizontal fillet welds in them. In the process of designing the structure of the welding robot, it is necessary to start from the following aspects to ensure the smooth completion of the welding task. A fully articulated welding robot is usually composed of a robot arm, a welding power source and a control system. Its mechanical arm mainly includes the base, rotary joints and swing joints, among which the mechanical arm, as one of the main components, is usually fixed on the base with the help of the spindle, which can rotate around the spindle in actual operation, while the other end is effectively connected to the mechanical arm with the help of joint grips, and through the interconnection between different joints, multiple mechanical arms can be connected to each other. Through the interconnection between different joints, multiple mechanical arms can be connected with the mechanical arm in order to ensure the stable operation of the mechanical arm during operation. The outer end of the mechanical arm is often set up with a lifting shaft, which does not exist alone, but needs to be connected with the welding gun, and at the same time, each mechanical arm and the shaft should be set up with the corresponding control motor, these control motors are independent, in its role and influence, to achieve intelligent and automated operation of the mechanical arm. In the specific welding process, the welding robot control system is mainly to adjust and control the working state of

each motor with the help of sensors, so as to drive each axis to rotate in an orderly manner, and to precisely control the mechanical large and small arms, and to carry out operations related to different forms of welds such as horizontal fillet welds in them. In the process of designing the structure of the welding robot, it is necessary to start from the following aspects to ensure the smooth completion of the welding task.

2.1. Multi-angle welding robot design

Since welding robots differ in the type of structure, the specific welding design should also be analyzed in relation to the actual situation. For the more commonly used right-angle coordinate welding robot in the welding process, there are three degrees of freedom in terms of the number of degrees of freedom, respectively, from the X, Y, Z axis for horizontal movement, back and forth movement and up and down movement, which also leads to the implementation of specific welding operations, the welding posture of the welding gun is often subject to certain restrictions and obstacles, and can only complete the welding work without other parts of the workpiece obscured. When the entire welding work environment changes, the welding position is obscured due to external factors, which will directly affect the execution of welding work, thus slowing down the progress of the entire project. By effectively connecting the welding gun to the rotary axis and enabling it to rotate around the rotary axis, the degrees of freedom of the welding robot can be further optimized and improved compared to the previous ones, increasing from three to four. The change in degrees of freedom will facilitate the welding work to a certain extent, allowing multi-angle welding of the same weld, and in this case, it can also effectively reduce other workpieces for In this case, it is also possible to reduce the obstruction of the welding part by other workpieces and to ensure that the welding gun can work properly. In addition, by adding a rotary axis to the welding robot with four degrees of freedom and using a high-performance CNC card to control multiple motors in real time and synchronization to drive the movement of the axes in five degrees of freedom, the coordinated movement of multiple axes can be ensured and the quality and efficiency of the entire welding process will be substantially improved [2].

The redundant degrees of freedom of fully articulated welding robots can be improved under certain circumstances and conditions by adding the number of articulated components so that they can be connected in an orderly manner with the large and small mechanical arms, thus generating redundant welding robots with any degree of freedom, while using servo-controlled motors to provide stable and accurate control of the operating state of the mechanical arms to ensure that the welding mechanical The arm can be operated automatically to complete the rotary, swing and other multi-directional cooperative movement, thus facilitating the application of welding work at different angles and in different directions, effectively helping the welding robot to find the obstacles in the welding and avoid them in time, saving welding time and improving welding efficiency at the same time. However, it should be noted that with the increasing redundancy of degrees of freedom, the actual operation of the welding robot, especially when driving and controlling operations, will gradually increase its own difficulty, and the manufacturing cost is far more than the general mechanical robot. Therefore, in the process of structural design of welding robots, technological innovation should be actively pursued, high-performance control systems should be developed, manufacturing costs should be controlled within a reasonable range, and the use of multi-degree-of-freedom welding robots should be gradually promoted [3].

2.2. Multi-welding robot workstation design

In the process of carrying out mechanical production, welding operations are often carried out on fixed welding lines, which require the participation of a large number of welding robots. In the application of welding robots, a complete welding robot workstation is really formed by using many different types of welding robots with a reasonable layout, in which advanced

controllers as well as general control systems, etc. are configured. Within the workstation, the different welding robot systems can be more carefully divided according to their functions and physical properties, becoming multiple relatively independent intelligent work bodies, and through mutual communication and exchange, cooperation and communication between multiple welding robots, truly ensuring the realization of the intelligent level of welding operations, so that when implementing operations, both in the level of automation and in the operation of In order to ensure that the welding operations are carried out efficiently, both in terms of the level of automation and the continuity and fluency of the operations, it is possible to complete welding tasks of different scales in a complex operating environment and ensure that the welding operations are completed with quality and quantity. It is important to note that a multi-welding robot workstation does not simply stack several basic welding robots together in actual operation; in fact, each welding robot has its own welding task to undertake and be responsible for in the process of implementing the operation. Therefore, in the actual operation, it is necessary to first set and control the type of welding joints and welding sequence of each welding robot, so as to effectively avoid and prevent the collision of different welding robots in the path and other aspects, which will hinder the execution of the task. Intelligent algorithmic programs, such as genetic algorithms, are used to constrain the paths of different welding robots so that they can maintain independent operation and truly form decentralized and independent intelligent subsystems, and in addition, with the help and support of electronic information technology, the collaboration between different subsystems is realized so that they can always provide services to the total system while operating independently [4].

3. Intelligent development direction of welding robots

Welding robots have been innovated and upgraded over a long period of time, both technologically and functionally, and its innovation is inevitable for the development of the times and has a significant relationship with the in-depth development of manufacturing in China. Especially in recent years, along with the further application and promotion of electronic information technology, for the optimization and improvement of welding robot also provides new ideas, through the welding robot and information technology integration, so that it can be engaged in the process of welding operations, towards a more intelligent as well as automated direction, in the innate technical advantages, engaged in welding work, will be able to automatically identify obstacles and timely avoidance It is also able to track the weld seam in real time, which is important for locating the position of the weld seam and ensuring the accuracy of the welding process.

3.1. Intelligent weld seam tracking

In the process of implementing welding work, affected by the welding environment and welding conditions, due to its certain complexity and specificity, welding often leads to deviations between the actual weld joint and the ideal welding position, and according to different engineering conditions, the welding difficulty will also be significantly different. Therefore, in the welding operation, according to the actual situation, the welding path and parameters need to be optimized and adjusted appropriately in a timely manner, through such a way and manner, the necessary correction of the deviation of the weld position existing in the previous welding. With the further development of electronic information technology, a variety of high-performance devices, such as arc sensors have begun to be widely used in the real-time acquisition of welding parameters, in its role and influence, the timely acquisition of arc voltage and other related information, in addition to the welding pool image information can also be achieved with the use of optical vision sensors. After the information is received, the collected information is transmitted to the main control system through certain channels and channels. The main control system systematically analyzes and processes the information and then sends

it to each driver of the welding robot, so that the welding path can be scientifically adjusted to ensure the accuracy of the welding direction and position. In addition, through the effective integration of different sensors and artificial neural network models, the welding robot is able to learn and associate itself with the changes in the welding work environment to achieve automatic tracking of the weld seam and intelligent adjustment of the path during the implementation of the specific operation [5].

3.2. Offline self-programming

In the continuous improvement of sensors and other equipment, welding robots also began to be able to use offline programming to make real-time feedback on the collected information, it can improve the welding efficiency and level of work through the specific analysis of the working environment in the state of the machine is not working, the actual welding task as well as the welding path on the basis of in-depth study of the information in the sensor, so as to improve the welding efficiency and level. However, from the perspective of the actual development of off-line self-programming in China, there are still certain difficulties in achieving fully automated programming with the support of existing technology, which still needs to be optimized in future technological updates. In the actual welding operation, with the aid of different types of sensors and artificial neural network models to provide more convenience for the welding robot to perform the relevant tasks, so that it can realize the automatic extraction of welding seam information, so as to clarify the detailed parameters of welding, in the analysis and statistics of the parameters to establish a personalized database of welding characteristics, so that in the specific working environment, in the welding command After acceptance, it is only necessary to input the specific parameters of the corresponding welded workpiece model by manual operation, so that the relevant processes of the welding process can be scientifically formulated with the help of the expert system in the database, and further systematic and standardized welding robot programs can be written to truly achieve autonomous welding [6].

4. Conclusion

In the process of industrial production, welding as an important process, its quality and efficiency and the final quality of the product is closely related to the presentation of the product, directly affecting the product later earnings. Therefore, in the relevant work, first of all, we must keep pace with the times, and actively carry out technical innovation and innovation, through the use of modern technology to promote the development of the welding process in the direction of intelligence and automation, with the form of welding robots, effectively improve welding efficiency, shorten the time of welding work, so that the whole work can be more convenient and efficient. When the welding robot is further optimized and improved, it needs to be considered from various aspects such as structural design, using intelligent control technology to significantly improve the automation level of the welding robot, so that it can provide more and more help for the construction and production activities in the current industrial field.

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