



Application of Virtual Simulation in Practical Teaching of Industrial Robot Specialty

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Abstract

Taking the teaching method of industrial robot training course as the research object, this paper puts forward the teaching scheme of industrial robot training course based on virtual simulation technology in terms of teaching content, teaching method and teaching means. Relying on the real system and simulation training room, a mobile phone shell grinding application scene training project of industrial robot is constructed. The simulation process and key points are described in detail. Then the training mode of combining virtual and real is realized. This teaching method effectively solves the contradiction between a large number of students and insufficient training equipment. And it greatly improves the efficiency of training teaching.

Keywords: industrial robot; practical teaching; virtual simulation

1 INTRODUCTION

Classroom teaching is a common activity of teaching and learning in a specific teaching situation. It is the basic organizational form of higher education and one of the important channels of talent training. It mainly includes teaching contents, teaching methods, evaluation means, training venues, training equipment, and teachers and so on. Industrial robots are more and more widely used in the fields of production and life. Due to the demand of the domestic market for industrial robot vocational skilled talents, many colleges and universities have set up industrial robot majors and courses. However, the industrial robot system is expensive. The maintenance cost of training equipment is high. And the quantity is difficult to meet the needs of training and teaching. Therefore, it is particularly necessary to apply virtual simulation technology to the teaching of industrial robot professional training courses.

In this paper, the virtual simulation technology is used to present and process the links of industrial robots in product processing and production in the virtual software. It can establish a virtual scene and realize the practical training teaching of product grinding operation. Through the virtual teaching, students can recognize and simulate the system operation tasks and system operation training. The virtual simulation classroom fully realizes the organic integration of knowledge and skills. Virtual operation learning is combined with practical operation verification.

2 ADVANTAGES OF VIRTUAL SIMULATION TEACHING OF INDUSTRIAL ROBOT

At present, some colleges and universities have the following problems in the process of practical teaching of industrial robot technology specialty. First, in terms of teaching content, due to the limitations of equipment cost and site, the phenomenon of insufficient proportion of practical courses in professional basic courses and professional core courses in some colleges and universities is still common. It cannot meet the teaching standards. It is influenced by traditional teaching ideas. There are some problems in the arrangement of teaching content, such as single content, lack of attraction, separation of theoretical and practical teaching and so on. Second, in terms of teaching means, there are monotonous teaching forms, mainly teaching. Thus, the students' practical ability is weak. Third, in terms of facility configuration, due to the rapid renewal of equipment, many application fields involved, expensive equipment and other factors, the equipment is difficult to meet the teaching requirements of all training courses, especially the projects of industrial robots in harsh environment and large working objects.

Therefore, virtual simulation experiment teaching conforms to the development trend and practical needs of educational informatization. And it plays an important role in the field of education. In particular, the construction and application of virtual simulation training room is one of the important components of modern education informatization. It is also one of the important breakthrough directions of College Teaching Reform under the new normal. The application of virtual

simulation technology in teaching will promote new education and teaching ideas, improve students' learning interest and attention, so as to improve the efficiency of education and teaching and the training quality of technical talents.

It can decompose and simulate the operation and maintenance of industrial robots. The application of virtual simulation classroom in industrial robot practice teaching is not only the need of industrial robot technology and vocational skills, but also can change the limitation of training conditions. It has the following advantages [1-3].

The simulation teaching of industrial robot is close to the practical application. The goal of the reform of experimental teaching system and teaching mode is realized. Industrial robot technology is applied in all walks of life. If it meets the teaching needs, the same number of equipment must reach the scale. In this way, the investment of funds limits the inability to purchase integrated systems for various industrial robot technology applications at the same time. In this case, on the premise of insufficient industrial robot training resources, the school adopts two teaching modes. One is the integration of theory and practice. The other is the teaching mode of project guidance task drive. It uses virtual simulation teaching to train students to master various application skills of industrial robot. It can model according to the original proportion on the virtual training platform. The function is consistent with the actual use environment. Students can program and debug all industrial robot applications consistent with the reality in the simulation software.

Industrial robot simulation teaching ensures the safety of students and equipment. As a high-end large carrier of mechatronics, the industrial robot must limit the speed when debugging and operating industrial robot in order to ensure the safety of equipment and students. In the whole process of practical teaching, teachers need full guidance and follow-up. Using virtual simulation teaching, students can establish an intuitive impression on the structure, operation and trajectory planning of industrial robots and other equipment, and clarify the operation procedures and methods before actual operation. This is more convenient for students to master skills.

Industrial robot simulation teaching develops students' innovative spirit and realizes personalized teaching objectives. Although industrial robot integration technology has been applied to many fields, there are still more application fields to be developed. Due to the flexibility and practicality of virtual simulation teaching, students can realize their innovative ideas in virtual space in simulation software [4-8].

3 VIRTUAL SIMULATION SOFTWARE

Due to the various brands and models of industrial robots, industrial robots of different brands have their own off-line programming software. The robot training project described in this paper selects interobot as the virtual simulation training platform for development. In the software, the robot can be operated and programmed like an actual teaching pendant. The scheme can be designed and verified by simulating the actual industrial robot workstation. The robot program can be directly downloaded to the actual robot system without any conversion. The model is built by the mainstream third-party modeling software. Thus, it can be imported. And the user can develop or maintain the robot program offline, which can significantly shorten the programming time and improve the program structure.

The software platform can complete the path planning, animation simulation, interference inspection, robot posture optimization, trajectory optimization and post code of robot processing. The software is a robot off-line programming application software developed by Huashu robot Co., Ltd. The software platform provides tool mode and workpiece mode. The robot library can be extended to any type of robot. The industrial robot training center of our school is a national productive training base jointly built by the school and Huashu robot Co., Ltd. The robot model coincides with the model library provided in the software platform, which is easier to carry out simulation training teaching. And it can be applied to grinding, engraving, laser welding, NC machining and other fields.

4 EXPERIMENTAL METHOD OF VIRTUAL SIMULATION PRACTICE TEACHING

In the traditional robot application teaching experiment, the peripheral mechanical devices have been built. Other sensors are also connected in place. Therefore, when doing the experiment, we mostly do point control and signal judgment on the actual program. Using virtual experiment simulation technology, students can not only program to realize the motion control of industrial robots, but also to establish the mechanical design and electrical control design ability of peripheral tooling [9-10]. The main steps needed to establish a virtual industrial robot application project is shown in Figure 1.

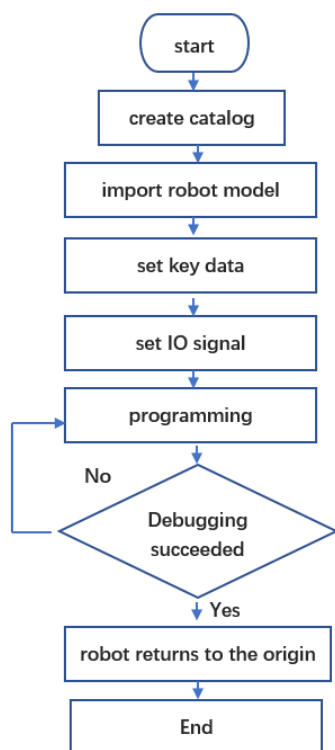


Figure 1 virtual industrial robot application project

5 TRAINING PROJECT OF VIRTUAL SIMULATION

Typical application cases of industrial robots include robot handling, palletizing, arc welding, die casting, grinding and so on. Using the animation simulation function of the software, various animations such as fixture action, material handling and peripheral equipment action are integrated in each workstation, so that the robot workstation highly simulates the realistic work tasks and work scenes. Thus, students can fully master the installation, configuration and debugging skills of the application of relevant industrial robots. It can let students master the application methods and skills of industrial robots through typical experimental simulation. This paper takes the industrial robot mobile phone shell polishing training project as an example to illustrate the application of virtual simulation practice teaching in professional courses.

The grinding robot is an automatic system. It can complete the grinding of workpieces by manipulating the end effector and fixedly connecting the grinding tool. Three basic modules are involved in virtual simulation training.

- Workstation and work scene. It includes robot components, workpiece coordinate system group and process group.
- Robot controller. The robot controller can select two functional modes. One is PC mode. The other is teaching pendant mode. The teaching pendant mode can obtain various data of the

controller in real time and realize the synchronous action of the simulated robot and the actual robot on the view. The PC mode can send action instructions and programs directly to the robot controller on the software and receive the feedback information of the controller.

- Robot property bar. This part mainly realizes the setting of the robot attitude in the simulation control.

The simulation of the training project mainly includes five parts.

(1) Creating an industrial robot workstation and system. First it is to select the robot. There are various types of robot models in the interrobot robot library. Also, you can establish your own robot model and store it in the system. The selected robot is shown in Figure 2. Next, you need to select tools. Select the tools needed in reality in the tool item. The grinding head is selected, as shown in Figure 3. Next, select the parts to be processed. The mobile phone shell is established, as shown in Figure 4.

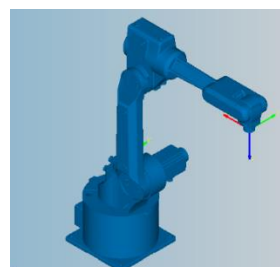


Figure 2 robot model

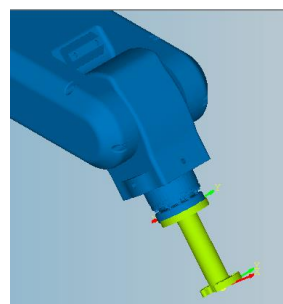


Figure 3 grinding tool

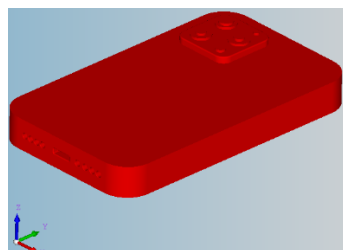


Figure 4 polishing object mobile phone shell

(2) Workpiece calibration is to calibrate the relative position of parts. When the relative position between robot and parts is fixed in reality, it is necessary to calibrate parts, so that the designed trajectory is meaningful.

(3) Creating the motion trajectory of industrial robot. The first is trajectory generation. Trajectory generation mainly includes wire and surface. It can select according to the needs. The selected track is generated by the face. Then the track offset is set. And the attitude of the track point is adjusted. The ideal track can be obtained through the adjustment, as shown in Figure 5. The grinding accuracy can be set through discrete parameters, including chord height error, maximum step size, number of paths and path type.

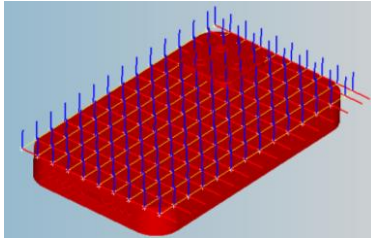


Figure 5 grinding trajectory

(4) Dynamic simulation. After the model is established, the motion simulation can be carried out. The simulation interface is mainly divided into four parts: simulation path selection, point parameter list contained in the simulation path, IPC controller interpolation and simulation control. In the simulation path selection, the user can select the path to be simulated, and the parameter information corresponding to the selected simulation path appears in the list, including X, Y, Z, RX, RY and RZ. PC controller interpolation includes loading program to IPC and loading, running, pausing and stopping operation after loading program to IPC. Simulation control includes simulation speed control, progress, reset, pause, rewind, play and fast forward operations. Figure 6 shows a grinding scene in the process of motion simulation.

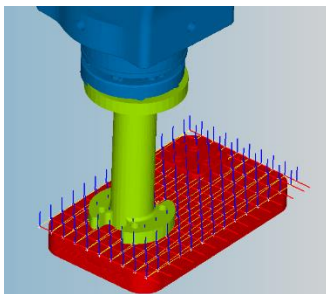


Figure 6 one grinding scene in dynamic simulation

(5) Making the robot simulation effect into an executable file. After completing the motion simulation, the robot code can be generated. According to the currently selected robot model, the corresponding robot post code can be generated to complete the whole process of the whole virtual simulation training project.

The integrated teaching scheme of virtual simulation of industrial robot has achieved good training results in the practical teaching and graduation design of the fourth session of students in our university. It solves the

problems of many students and insufficient training equipment and funds. It reduces the training cost and improves the efficiency of practical training.

6 CONCLUSION

Using the virtual reality simulation technology, the training projects of industrial robots are presented in the virtual software. And a virtual scene is established to realize the virtual simulation teaching of robot handling, palletizing, arc welding, die-casting, grinding and other training projects, so as to make the practical teaching process more intuitive and vivid. It is helpful for students to gain a comprehensive understanding of the operation of industrial robots and the development process of each project, It solves the dilemma of insufficient real training system.

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