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## Structural Design of SCARA handling Robot

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### Abstract

SCARA robot is widely used in assembly industry because of its high precision of repeated positioning. Through a pair of rotating joints in the X-Y plane to achieve rapid positioning and a rotating joint, a moving joint in Z direction rotation and stretching motion. In automatic assembly line, SCARA robot has its own advantages of position grab and quick placement. However, there are some limitations in some food handling processes. According to the requirements of handling function, working characteristics and application field of SCARA robot, the structure design of SCARA robot with five degrees of freedom is completed in this paper.

### Keywords

SCARA robot; five degrees of freedom; structural design.

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## 1. Research background

In the 1950 s, the world's first programmable robot was born. At first, the robot with storage can only achieve point-to-point teaching reproduction motion. Until the 1960s, AMF Company of the United States successfully designed and manufactured a kind of robot in the form of cylindrical coordinates, which marked the birth of the earliest industrial robot in the world.

With the need of industrial production, industrial robots are gradually used in automobile, motorcycle, motor, electronics and other industries. At the same time, these industries also greatly promote the development of the robot industry. At present, many industrial robots choose SCARA design scheme. It not only has compact structure, large workspace, flexible operation, but also has the characteristics of high cost performance ratio and high precision of repeated positioning. SCARA industrial robot is constructed with light and convenient structure. Able to complete high positioning accuracy and high speed steps, is gradually used in the electronic motor, electronic products, packaging, metal products and other industries. Can Cooperate with the peripheral control unit, quickly generate the robot workstation, complete the important working procedures such as lock screw, assemble, load transfer, solder, handling, packing and so on the production line, Even in the complex and precise production line process can easily meet the requirements specification. As shown in the figure 1.1.

## 2. Research status of SCARA Robot

The SCARA planar joint robot developed by Japan is the most widely used robot at present. Originally invented by Yamanashi University in 1978, the robot has been widely used in assembly operations since then, with four degrees of freedom of movement. The series of manipulators have finite stiffness in the four directions of their action space, and infinite stiffness in the remaining two directions. SCARA robots are compact, flexible, fast, and have high position accuracy. The use of it greatly improves the adaptability of robot to complex assembly tasks, at the same time, it also reduces the cost and improves the work[1]. Space utilization ratio. It has been more than 40 years since the invention of SCARA industrial robot from Miyano, but the SCARA robot is still regarded as an indispensable

element in automatic production by virtue of the structure and application advantages mentioned above. In addition to its wide application, SCARA industrial robots have been more developed and improved, such as Epson's SCARA robots BN and BL. in mechanical manufacturing. With the intensification of market competition, a large number of suitable assembly and handling robots are urgently needed in the process of production development in order to improve the production efficiency and quality and reduce the production cost[2]. The research of robot, especially the direct drive of high-precision robot, has become an urgent task in the research of industrial robot.



Figure 1.1

### 3. The overall Design of SCARA Human

#### 3.1 The basic structure of SCARA moving Robot

SCARA robot is the most widely used robot in the handling operation of the production line. In the design of SCARA handling robot mechanism, the flexible coordination of each joint axis of the robot should be fully considered to ensure that the workpiece can be operated in the space range of the SCARA robot arm to minimize the vibration. The smooth movement can reduce the damage degree, reduce the cost and working time, and improve the handling efficiency of the SCARA handling robot[3].

#### 3.2 Comparison of Mechanical Transmission schemes

According to the comparison of the current SCARA robot ontology design scheme reference to "domestic typical Industrial Robot Atlas", two transmission schemes are preliminarily selected:

Scheme 1: the first and second degree of freedom of rotation all choose the deceleration motor drive, the precision is high, the transmission ratio is high, the efficiency is high, the noise is small, the vibration is small, the transmission part parts are standard parts, easy to purchase, easy to install.

The third and fourth rotational degrees of freedom select synchronous belt transmission with high transmission precision compact structure constant transmission ratio high power and high efficiency but high installation requirements and limited load capacity.

Scheme two: the first rotational degree of freedom selects the gear deceleration drive, the second rotational freedom adopts the secondary synchronous tooth belt transmission, but the installation requirement is high, the structure is also more complex.

The third degree of freedom chooses stepper reducer motor to drive the screw and nut directly, changing the rotating motion into linear motion, but the relative weight of synchronous gear belt is larger, so the output torque of the motor is bigger and the machining requirement is higher.

Both schemes can be realized theoretically, but the first scheme is simple in structure, few components and more standard parts, which is easy to realize; the second scheme is complex in structure, more gears are used, special equipment is needed to process, and the shape of positioning parts is more irregular, processing and installation are more complex.

### 3.3 Design of SCARA handling Robot

The SCARA robot mechanism is flexible enough to ensure that the handling meets the requirements[4]. On the basis of the four-degree-of-freedom (SCARA) robot structure, increasing the degree of freedom can increase the flexibility and versatility of the mechanism and enable the robot to accomplish complex special tasks. At present, the SCARA robot is used in the automatic production line of the food industry to complete the handling of the food workpiece, and the state of the work piece before and after handling is not changed relative to the vertical direction[5]. It is of great significance to study the structure of SCARA robot by adding one degree of freedom to the handling and packing of food.

In this paper, the SCARA moving robot is designed to increase one degree of freedom at the end of the robot, that is, swing joint, and increase its flexibility. The swinging mechanism of the end actuator makes the horizontal workpiece grab and put into vertical state. After the design of the mechanism of the SCARA moving robot, the integral assembly modeling is carried out in the 3D modeling software. Technical parameters: waist: 260mm, arm: 410mm,  $\pm 120^\circ$  (rotary stroke), forearm: 400mm,  $\pm 120^\circ$  (rotary stroke), rotation angle of rotation axis R axis:  $-360 \sim 360^\circ$ , U-axis swing angle  $-90 \sim 90^\circ$ . As shown in the figure 2.1.

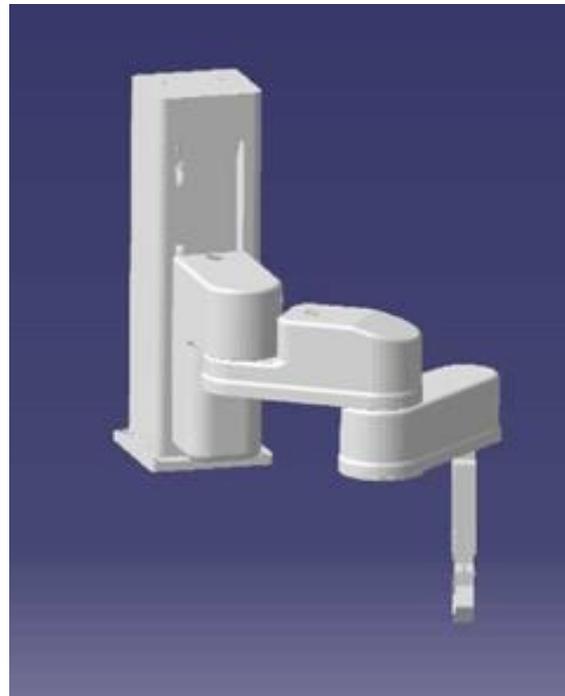


Figure2.1

## 4. Summary

According to the requirements, working characteristics and application field of SCARA robot, the swing mechanism is added to the structure of four-degree-of-freedom SCARA robot, and a five-degree-of-freedom SCARA handling robot suitable for food handling and packing is proposed in this paper. It can increase the flexibility and versatility of the mechanism, and complete the structure

design of the five-degree-of-freedom SCARA handling robot. By reading this article, I hope to help more people who love the robotics industry, especially the SCARA type.

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