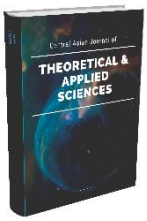

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Servo Motors and Stepper Motors: Their Difference

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Abstract: *There is a type of motor similar to DC motors and widely used in industry. These are stepper and servo motors. This article describes the advantages and areas of application of two types of motors. Stepper motors show motion as a smooth rotation. Servomotors are combined with reducers, control drives, and linear drives. This system precisely moves the tool from one point to another.*

Introduction

A servo motor is, of course, very similar to a conventional DC motor (Figure 1) – there are AC and DC servo motors, brushed and brushless motors, and synchronous or asynchronous motors. What makes servo motors different from conventional motors is the feedback loop and drive system.

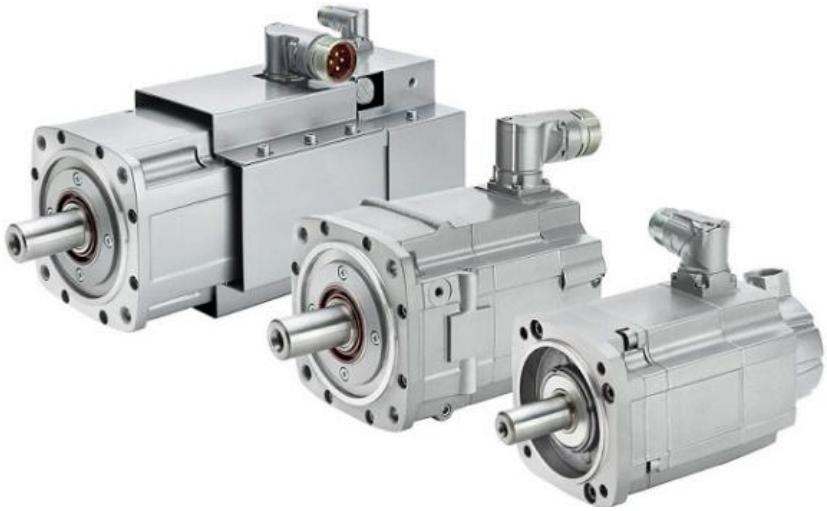

Figure 1 Servo motor

Each servomotor has a sensor (encoder) and a drive controller: the encoder reports the position of the shaft to the drive controller, thus creating a closed system. The drive system amplifies and filters the incoming voltage before supplying current to the motor. A programmable logic controller (PLC) informs

the drive system of the motor's position and speed. Motor speed is controlled by PWM (Pulse Width Modulation) and sine wave signals depending on the motor's AC or DC current.

Figure 2. AC servomotor

As with a conventional AC motor, adjusting the frequency changes the speed of the motor. Just like a regular DC motor, the alternating voltage changes the speed. An AC servo motor drive (Figure 2) receives an electrical signal from a PLC or other controller and outputs a current at a specific frequency until the drive system reaches the desired motor shaft position.

What is a stepper motor? A stepper motor also uses a rotating magnetic field to convert electric current into rotary motion, but the magnetic pole density is much higher. Stepper motors divide a complete revolution into many equal segments. When one magnetic pole is energized, the output shaft drives one segment or one “step” giving it the name “stepper” motor. When high-frequency power is applied to the poles in series, the motion appears as a smooth rotation.

This type of control is usually implemented with special output cards that can operate at the high output frequency required. As the density of segments increases, the accuracy of the position of the output shaft also increases. Stepper motors usually do not have encoders because the segments are clearly separated. A stepper motor can be commanded to rotate a certain number of degrees by counting the number of times the outputs are energized.

Application of servomotors

Typically, a servo motor is coupled with reducers, a control drive, and a linear drive, which can be either a lead screw or a pulley and belt system that converts rotary motion into linear motion. This system precisely moves the tool from one point to another. In PLC, the reduction gear ratio and the drive gear ratio are included in the scaling algorithm, so when the PLC commands the servo drive to move a certain distance at a certain speed after the encoder gives the correct number of revolutions, the drive system can calculate a certain frequency and may stop servo drive. This type of system is typically used in pick-up and drop-off stations where a component needs to be picked up from one location and placed in another location. Servo motors are excellent motors for material handling stations because of their speed and accuracy. The articulated robot has six servo motors and gearboxes that move the end effector in a controlled manner. Thanks to the high torque of the servomotors, the robots can move large payloads over

the entire working range. Servo motors also have the ability to precisely control the output torque. This feature makes servo motors an excellent choice for click applications.

Comparison of stepper motors and servo motors. A servo motor and a stepper motor share a common goal of providing precise speed and position control, but the design of the two motors is different. The servo motor design is closer to the traditional motor but has a closed system and advanced control technology. A stepper motor is different in design and does not require a feedback system to achieve positioning, although many stepper systems benefit from the addition of an encoder. Some applications for these motors overlap because of their similar purposes, but when high speeds and high torques are required, a servo motor is a better choice. A stepper motor is the best choice when lower speed and more precise positioning is required.

Torque

When designing a drive system, there are many considerations to consider before choosing a stepper motor or servo motor. I like to start with a moment. If your system needs a lot of torque, a servo motor is the best solution. A characteristic feature of a stepper motor is its holding torque at zero speed. If the job requires positioning or holding the tool in place, a stepper motor is a better choice.

In terms of accuracy, a typical servo motor has an accuracy of about ±0.02 degrees, while a stepper motor has an accuracy of ±0.005 degrees.

Conclusion

Looking at the last criteria we'll look at, stepper motors are by design very quick to reposition - just activate a few outputs and the output shaft should turn a few degrees. Servomotors have a slight position error before starting to move, a delay that may seem short to the human eye, but as the cutting tool moves along the rotating shaft, this delay can cause surface finish imperfections.

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