Stepper motor

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Stepper motor is the electric pulse signals into angular displacement or linear displacement of the open-loop stepper motor control element pieces. In the case of non-overloaded, the motor speed, stop position depends only on the pulse frequency and pulse number, regardless of load changes, when the driver receives a step pulse signal, it will drive a stepper motor to Set the direction of rotation of a fixed angle, called the "step angle", which the angle of rotation is fixed step by step operation. Number of pulses can be controlled by controlling the angular displacement, so as to achieve accurate positioning purposes; the same time by controlling the pulse frequency to control the motor rotation speed and acceleration, to achieve speed control purposes.

Work: Induction motor is a stepper motor, does it work is the use of electronic circuits, the DC power supply into a time-sharing, multi-phase timing control current, this current stepper motor power supply, the stepper motor to work properly , The drive is sharing power supply for the stepper motor, the polyphase timing controller Although the stepper motor has been widely used, but the stepper motor does not like a normal DC motor, AC motor in the conventional use. It must be double-ring pulse signal, power driver circuit composed of the control system can be used. Therefore, it is not easy with a good stepping motor, which involves mechanical, electrical,

electronics and computers, and many other specialized knowledge.

As the stepper motor actuators, electromechanical integration, one of the key products, widely used in a variety of automatic control systems. With the development of microelectronics and computer technology, increasing demand for stepper motor, has applications in all areas of the national economy.

Categories:

Now more commonly used include the reaction of step motor stepper motor (VR), permanent magnet stepper motor (PM), hybrid stepper motors (HB) and single-phase stepper motor.

Permanent magnet stepper motor

Permanent magnet stepper motor is generally two-phase, torque, and smaller, usually 7.5 degree step angle or 15 degrees;

Permanent magnet stepper motor output torque, dynamic performance, but a large step angle:

Reaction Stepper Motor

Reaction is generally three-phase stepping motor can achieve high torque output, step angle of 1.5 degrees is generally, but the noise and vibration are large. Reaction by the stepper motor rotor magnetic circuit made of soft magnetic materials, a number of the stator phase excitation winding, the use of permeability changes in torque.

Step Motor simple structure, low production costs, step angle is small; but the dynamic performance is poor.

Hybrid.Stepping Motor

Hybrid Step Motor combines reactive, permanent magnet stepper motors of both, it's a small step angle, contribute a large, dynamic performance, is currently the highest performance stepper motor. It is also sometimes referred to as Permanent Magnet Induction Stepping Motor. It consists of two phases and the five-phase: the general two-phase step angle of 1.8 degrees and the general five-phase step angle 0.72 degrees. The most widely used Stepper Motor.Stepper motor drive for energy saving

Three-phase stepper motor drive special features:

■ 180% low torque output, low frequency characteristics of a good run

■ Maximum output frequency 600Hz, high-speed motor control

■ full range of detection of protection (over voltage, under voltage, overload) instantaneous power failure restart

■ acceleration, deceleration, such as dynamic change in the stall protection function to prevent

■ Electrical dynamic parameters of automatic recognition function to ensure stability and accuracy of the system

■ quick response and high-speed shutdown

■ abundant and flexible input and output interface and control, versatility

■ use of SMT production and three full-mount anti-paint treatment process, product stability and high

■ full range of Siemens IGBT power devices using the latest, to ensure the quality of high-quality

Basic principles

Usually for the permanent magnet rotor motor, when current flows through the stator windings, the stator windings produce a magnetic field vector. The magnetic field will lead to a rotor angle of the magnetic field makes the direction of a rotor and the stator's magnetic field direction. When the stator magnetic field vector rotating at an angle. As the rotor magnetic field is also transferred from another perspective. An electrical pulse for each input, the motor turning a point forward. It is the angular displacement of the output and input the number of pulses proportional to speed and pulse frequency is proportional to. Power to change the order of winding, the motor will reverse. Therefore, the number of available control pulse, frequency and power the motor windings of each phase in order to control the stepper motor rotation. Reaction Stepper Motor

As the response to stepping motor works is relatively simple. The following describes the first principle of three-phase stepping motor response.

1, the structure: uniformly distributed rotor with many small teeth, the stator excitation windings of three teeth, the geometric axis of the rotor tooth axis in order were staggered. 0,1 / 3 , 2 / 3 , (adjacent to the two axes of the rotor tooth pitch distance between the said), that is, with the teeth a relatively homogeneous A, B and staggered tooth 2 to the right 1 / 3 , C and the right to stagger tooth 3 2 / 3 , A 'and the tooth 5 is relatively homogeneous, (A' is A, is the gear teeth 5 1) The following is the rotor's expansion plan

2, rotation: If the A-phase power, B, C phase is not energized, the magnetic field, alignment of teeth 1 and A, (without any power of the rotor are the same the following). Such as the B-phase power, A, C phase is not energized, gear 2, and B

should be aligned, when the rotor over to the right 1 / 3 , this time offset teeth 3 and C 1 / 3 , teeth 4 and A shift (-1 / 3 te) = 2 / 3 . Such as the C-phase power, A, B phase is not energized, gear 3, and C should be aligned, this time right off the rotor Youxiang 1 / 3 , 4 and A gear shift time is 1 / 3 alignment. Such as the A-phase power, B, C phase is not energized, 4 and A-aligned teeth, the rotor Youxiang right over 1 / 3 so after A, B, C, A are energized, gear 4 (ie, the previous tooth 1 teeth) to the A-phase, rotor to the right around a pitch, if you continue to press the A, B, C, A ... ... power, the motor for each step (per pulse) 1 / 3 , Rotate Right. Such as by A, C, B, A ... ... power, the motor to reverse. This shows that: the location and speed of motor conduction times by the (number of pulses) and frequency into one relationship. The direction determined by the conductivity of the order. However, out of torque, smooth, noise and reduce the angle considerations. Often with A-AB-B-BC-C-CA-A this conductive state, so that each step the original 1 / 3 changed to 1 / 6 Even through different combinations of two-phase current, so 1 / 3 into 1 / 12 , 1 / 24, te, which is the basic theory of the motor-driven basis for subdivision. Easily introduced: m phase on the stator excitation windings, the axis of the rotor tooth axis were offset 1 / m, 2 / m ... ... (m-1) / m, 1. And conductivity at a certain phase sequence reversing motor can be controlled - this is the rotation of the physical conditions. As long as we meet this condition can theoretically create any phase stepper motor, because of cost, and many other considerations, the market generally two, three, four, five-phase is more.

3, the torque: the motor once energized, will produce between the stator and rotor magnetic field (magnetic flux Φ) when the rotor and stator stagger angle to produce force F and (dΦ / dθ) is proportional to S the magnetic flux Φ = Br * S Br for the flux density, F and S for the magnetic area of L * D * Br core is proportional to L, effective length, D is rotor diameter Br = N • I / RN • I was excited winding ampere turns (current x turns) R for the magnetic resistance. Torque = force * radius of the torque and the motor turns the effective volume * An * is proportional to the flux density (only consider the linear state), therefore, the greater the effective volume of the motor, the greater the excitation ampere turns, the smaller air gap between stator and rotor, the motor torque, and vice versa.

Induction Stepping Motor

1,features: Induction, compared with the traditional reactive, structural

reinforced with a permanent magnet rotor, in order to provide the working point of soft magnetic materials, and the stator excitation magnetic field changes only need to provide to provide the operating point of the consumption of magnetic materials energy, so the motor efficiency, current, low heat. Due to the presence of permanent magnets, the motor has a strong EMF, the damping effect of its own good, it is relatively stable during operation, low noise, low frequency vibration. Induction can be seen as somewhat low-speed synchronous motor. A four-phase motor can be used for four-phase operation, but also can be used for two-phase operation. (Must be bipolar voltage drive), while the motor is not so reactive. For example: four phase, eight-phase operation (A-AB-B-BC-C-CD-D-DA-A) can use two-phase eight-shot run. Not difficult to find the conditions for C =, D =. a two-phase motor's internal winding consistent with the four-phase motors, small power motors are generally directly connected to the second phase, the power of larger motor, in order to facilitate the use and flexible to change the dynamic characteristics of the motor, its external connections often lead to eight (four-phase), so that when used either as a four-phase motors used, can be used for two-phase motor winding in series or parallel.

2,classificationInduction motors can be divided in phases: two-phase motor, three phase motor, four-phase motor, five-phase motor. The frame size (motor diameter) can be divided into: 42BYG (BYG the Induction Stepping motor code), 57BYG, 86BYG, 110BYG, (international standard), and like 70BYG, 90BYG, 130BYG and so are the national standards.

3, the stepper motor phase number of static indicators of terms: very differently on the N, S the number of magnetic field excitation coil. Common m said. Beat number: complete the necessary cyclical changes in a magnetic field pulses or conducting state with n said, or that turned a pitch angle of the motor pulses needed to four-phase motor, for example, a four-phase four-shot operation mode that AB -BC-CD-DA-AB, shot eight four-phase operation mode that

A-AB-B-BC-C-CD-D-DA-A.Step angle: corresponds to a pulse signal, the angular displacement of the rotor turned with θ said. θ = 360 degrees (the rotor teeth number of J * run shot), the conventional two, four-phase, the rotor teeth 50 tooth motor as an example. Four step run-time step angle θ = 360 ° / (50 * 4) = 1.8 degrees (commonly called the whole step), eight-shot running step angle θ = 360 ° / (50 * 8) = 0.9 degrees (commonly known as half step.) Location torque: the motor is not energized in the state, its locked rotor torque (as well as by the magnetic field profile

of harmonics caused by mechanical error) static torque: the motor under the rated static electricity, the motor without rotation, the motor shaft locking torque. The motor torque is a measure of volume (geometry) standards, and drive voltage and drive power, etc. has nothing to do. Although the static torque is proportional to the electromagnetic magnetizing ampere turns, and fixed air gap between the rotor teeth on, but over-use of reduced air gap, increase the excitation ampere-turns to increase the static torque is not desirable, this will cause the motor heating and mechanical noise.

4, the dynamic indicators and terminology:

1, step angle accuracy: turn a stepper motor step angle for each actual value with the theoretical value of the error. Expressed as a percentage: Error / Step Angle * 100%. Its value is the number of different running different beat, four beat running should be within 5%, eight runs should take less than 15%.

2 step: the motor running operation steps, is not equal to the theoretical number of steps. Called the step.

3, offset angle: the axis of the rotor tooth offset angle of the axis of the stator teeth, the motor is running there will be misalignment angle, the error caused by the misalignment angle, using division drive can not be solved.

4, the maximum no-load starting frequency: a drive motor in the form of voltage and rated current, in the case without load, the maximum frequency can be started directly.

5, the maximum operating frequency of load: a drive motor in the form of voltage and rated current, the motor maximum speed with no load frequency.

6, running torque-frequency characteristics: the motor under test conditions in a measured frequency of operation between the output torque and running torque curve is called the frequency characteristic curve which is the motor number of the most important dynamic is the fundamental basis for motor selection. As shown below: There used to frequency characteristics of other features, starting frequency characteristics. Electrical Once selected, the motor torque to determine the static and dynamic torque is not the case, the motor torque depends on the dynamics of the average motor current (rather than static current), the average current increases, the greater the output torque of the motor, that motor frequency characteristics of the more hard. As shown below: where the maximum curve 3 current, or voltages; curve a minimum current, or voltage is the lowest curve and the load maximum speed of the

intersection point of the load. For the average current, voltage increase as much as possible, so that the use of small inductor high current motor.

7, the resonance point of the motor: stepping motor has a fixed resonance region, two, four-phase Induction in the resonance region is generally between 180-250pps (1.8 degree step angle) or about the 400pps (step angle 0.9 degrees), the higher the motor drive voltage, motor current increases, the lighter the load, the smaller the size the motor, the resonance shift upward, and vice versa, the motor output torque is large, yet further, and the whole system noise reduction, the general operating point should be offset more resonance.

8, motor reversing control: timing is energized when the motor windings AB-BC-CD-DA or () is a positive turn, power the timing for the DA-CD-BC-AB or () when reversed.

Some of the basic parameters of the stepper motor

Natural step angle motor

It said each of the control system sends a pulse signal, the motor rotation angle. Motor factory, a step angle is given a value, such as 86BYG250A motors is given in 0.9 ° / 1.8 ° (half-step work that is 0.9 °, when the work of the whole step 1.8 °), the step angle can be called 'natural step angle motor', which is not necessarily true when the actual work the motor step angle, the real step angle and drive on.

Stepper motor step angle is usually the general computing β calculated as follows.

$\beta = 360° / (Z \cdot m \cdot K)$

Where β-stepper motor step angle;

Z-rotor teeth;m-phase stepper motor number;

K-control factor, the film is the ratio of the number of coefficients with the phase number

Phase stepper motor

Refers to the number of the motor coil group, the commonly used two-phase, three phase, four-phase, five-phase stepper motor. Different number of motor phases, the step angle is different, the general two-phase motor step angle of 0.9 ° / 1.8 °, three-phase for the 0.75 ° / 1.5 °, five-phase for the 0.36 ° / 0.72 °. In the absence of sub-drive, the user select a different number of phases depends mainly on the stepper motor step angle to meet their own requirements. If you use the sub-drive, the 'phases' will become meaningless, the user simply changes in the subdivision number on the drive, you can change the step angle.

Stepper motor is energized but no rotation, the stator locked rotor torque. It is the stepper motor one of the most important parameters, usually when the stepper motor torque at low speed near the holding torque. As the stepper motor's output torque increases with the speed and continuous attenuation, output power increases with the speed change, so keep the torque stepper motor to become a measure of one of the most important parameters. For example, when people say 2N.m the stepper motor in case of no special note is the holding torque of the stepper motor for the 2N.m.

DETENT TORQUE:

Stepper motor is not energized, the stator locked rotor torque. DETENT TORQUE translation in the country there is no uniform way, easy to misunderstand us; the reaction is not a permanent magnet stepper motor rotor material, so it does not .

Characteristics of the stepper motor

1. The general accuracy of the stepper motor step angle of 3-5%, and not cumulative.
2. Appearance of the stepper motor to allow the maximum temperature.

Stepper motor causes the motor temperature is too high the first magnetic demagnetization, resulting in loss of torque down even further, so the motor surface temperature should be the maximum allowed depending on the motor demagnetization of magnetic material points; Generally speaking, the magnetic demagnetization points are above 130 degrees Celsius, and some even as high as 200 degrees Celsius, so the stepper motor surface temperature of 80-90 degrees Celsius is normal.

3. Stepper motor torque will decrease with the increase of speed.

When the stepper motor rotates, the motor winding inductance of each phase will form a reverse electromotive force; the higher the frequency the greater the back emf. In its role, the motor with frequency (or speed) increases with the phase current decrease

4. Low-speed stepper motor can operate normally, but if not higher than a certain speed to start, accompanied by howling.

Stepper motor has a technical parameters: no-load starting frequency, ie the stepper motor with no load to start the normal pulse frequency, pulse frequency is higher than the value if the motor does not start, you may lose steps or stall occurs. In the case of a load, start frequency should be lower. If you want the motor to achieve

high-speed rotation, the pulse frequency should speed up the process, which started lower frequency, and then rise by a certain acceleration of the desired frequency (motor speed from low rise to high-speed).

Stepper motor with its significant features, in the era of digital manufacturing play an important purpose. Along with the different development of digital technology and the stepper motor itself, improvements in technology, the stepper motor will be applied in more fields.