Research on Mechanical Performance Testing of Ultrasound Motor in High Temperature Environment Based on Sociological Theory

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Abstract: Ultrasonic motors (USM) are a type of micro-motor that uses the ultrasonic frequency vibration of an elastomer to drive a drive load. Compared with the traditional electromagnetic motor, the ultrasonic motor has many remarkable advantages such as low speed and large torque, fast response, high positioning accuracy, simple structure, large self-locking power failure and no interference from magnetic fields. Because the trust relationship between different users is different, the strength of trust relationships of different users in different fields is also different, making the uncertainty of trust relationship the biggest challenge of trust prediction. The performance change of ultrasonic motor in special environment including high temperature environment is one of the research items that ultrasonic motor must carry out before use. Taking the method of trial-producing, testing, improving and re-trial-producing the prototype, the decrease of friction coefficient of rotor friction material of ultrasonic motor reduces the output speed of ultrasonic motor. The increase in pre-pressure further reduces the output speed of the ultrasonic motor. Finally, the output speed of the ultrasonic motor decreases.

1. Introduction

Ultrasound motor (USM) is a kind of micro-motor, which uses the ultrasonic frequency vibration of elastomer to drive the load. It has the advantages of fast response, high positioning accuracy and no interference from magnetic field [1]. It uses the inverse piezoelectric effect of piezoelectric ceramics to convert electrical energy into mechanical energy. In the ultrasonic frequency band, the rotor is driven to rotate by the resonance amplification of elastomer and the friction between stator and rotor [2]. Compared with traditional electromagnetic motors, ultrasonic motors have many remarkable advantages, such as low speed, large torque, fast response, high positioning accuracy, simple structure, large power-off self-locking force and no magnetic field interference. Due to the different trust relationships between different users, the same users have different trust relationship strengths in different fields, making the uncertainty of trust relationship the biggest challenge of trust prediction [3]. The driving performance of the ultrasonic motor needs to be studied. Thereby, the corresponding relationship between the rotational speed and the torque of the motor at different excitation frequencies is obtained.

Compared with the traditional electromagnetic motor, the ultrasonic motor has the characteristics of large output torque and its own weight ratio, fast response and flexible structural design [4]. It has broad application prospects in the aerospace field, especially for satellites with high magnetic cleanliness [5]. The traveling wave type rotary ultrasonic motor has many researches, and has high operational stability and reliability. Therefore, it is more widely used than other types of ultrasonic motors. In the design process of micro-rotary ultrasonic motor, various performance parameters of the motor must be obtained through testing [6]. The performance change of an ultrasonic motor in a special environment including a high temperature environment is one of the research projects that must be carried out before the ultrasonic motor is used [7]. With the increasing demand for micro-motors, micro-rotating ultrasonic motors have also appeared, which can be used in low-speed and small-torque environments. For the large-scale application of ultrasonic motors with independent intellectual property rights in China, there are still many topics to be studied [8]. Including some special occasions, the performance of ultrasonic motor in such environment and so on. High and low temperature environment will affect the performance of metal materials,

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piezoelectric ceramics, friction materials and so on.

2. Mechanical Characteristic Testing Technology of Micro Motor

Due to the lack of damping of the single-rotor-double-rotor structure damping, the vibration isolation method is applied to apply axial displacement constraints to the common rotating shaft. The single-rotor-double-rotor structure vibration caused by the amplitude fluctuation of the traveling wave on the stator surface is eliminated, in order to solve the problem of the two-way traveling wave operation. During the stretching process, if it is not controlled, it will eject quickly by its own energy storage. This can have a large impact, which is likely to cause tearing of the reel or structural deformation, greatly reducing the accuracy of the product. The effect of temperature on the drive control section is mainly reflected in the fact that the characteristics of the IC chip drift with temperature [9]. In turn, the frequency and amplitude of the drive signal output by the driver change. The ultrasonic motor is used as a drive source. Therefore, when studying the driving performance of the ultrasonic motor, the reverse load is applied to it in most cases. That is, the direction of load torque is opposite to the direction of rotation of the ultrasonic motor. According to the measurement results, the motor design is optimized, the design theory is improved, and the motor performance is improved. Finally, the qualified prototype which fully meets the design parameters of the motor is obtained.

Each behavior has its own goal or task, and its input can be used as the sensor information of the agent or the output of other behaviors in the system. Accordingly, the output of each agent is sent to its actuator to control the formation of the agent. Because of its particularity, multi-agent vision positioning must be able to transmit information anytime and anywhere, monitor and analyze data accurately, and achieve efficient interaction through the network. Data acquisition, visual positioning and data receiving module transmit data through interface. The data format is shown in Table 1.

Table 1 Data format

Name	Length
Start sign	3
Data length	5
Command word	8
Data section	11
Termination code	8

The speed control uses a traditional proportional control algorithm to manually adjust the scale factor based on actual experience. The speed control program calculates the speed value in real time based on the feedback signal from the encoder. In the reel type stretching mechanism, the ultrasonic motor is used as a load of the elastic reel for the purpose of dragging and retarding the elastic reel stretching. For a power machine or a brake machine that works at a constant speed, when its main shaft is subjected to a torque, the balance torque in the opposite direction must be simultaneously applied to its body. The speed control mode of the ultrasonic motor usually has frequency modulation speed regulation, voltage regulation speed regulation and phase adjustment speed regulation. The performance change of an ultrasonic motor in a special environment including a high temperature environment is one of the research projects that must be carried out before the ultrasonic motor is used. For the ultrasonic motor, the elastic drum imposes a load in the same direction, that is, the direction of load torque is the same as the direction of rotation of the ultrasonic motor. For the ultrasonic motor, the elastic drum imposes a load in the same direction, that is, the direction of load torque is the same as the direction of rotation of the ultrasonic motor.

The social demand for mechanical products is constantly showing a large number of diversification, personalization, product orders are gradually showing the characteristics of multi-varieties, small batches. For most engineering problems, there are few analytical solutions because of the complex geometry of the object or the nonlinearity of some characteristics of the

problem. Project quality control refers to the control of the progress of each stage and the deadline for the final completion of the project in the process of project implementation. The process duration obeys lognormal distribution. Figure 1 is the result of critical chain planning.

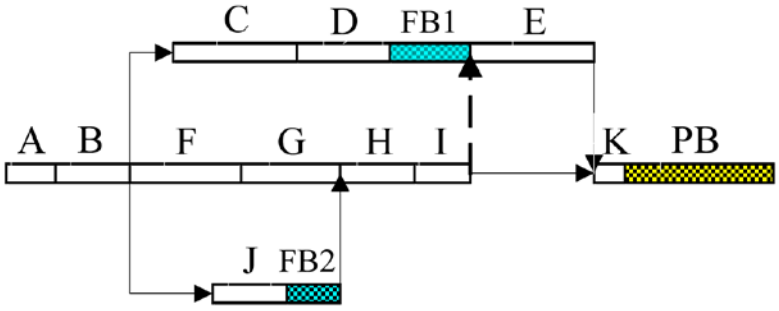

Fig. 1 Key Chain Layout Planning Results

According to the error size, the speed command is given again, and the speed of the motor is controlled to be stable. Because of the contact friction transmission between the stator and rotor of the ultrasonic motor, and the speed of the ultrasonic motor is changed by changing the driving frequency. Social network is a social structure composed of multiple nodes, which can reflect the relationship between users in the real world. Therefore, the principles, principles, viewpoints and methods of sociological theory are applied to the study of trust relationship among users in social networks. The frequency of the output signal of the driver can not change continuously like the analog circuit, and the frequency will change abruptly, which will lead to the sudden change of the speed of the ultrasonic motor. The device applies a method in which the deformation of the elastic element causes a change in the characteristics of the torque angle, the magnetic permeability, and the like, and the torque is obtained by the method of testing the torque. Carry out research on the driving performance of ultrasonic motor under the same direction load and the influence of vacuum high and low temperature environment on it. This is of great significance for optimizing the design of the ultrasonic motor, ensuring the safe and reliable implementation of the roll-type extension mechanism, and promoting the promotion and application of the ultrasonic motor in the aerospace field.

3. Influence of Temperature on System Performance

Speed control uses a number of intermediate speed transition methods, with relative lag, and its control accuracy is limited. Based on the statistical analysis method, high-precision trust relationship prediction is realized by integrating multiple trust-related dimensions, such as historical information, situation information, and reputation information. The position control adopts the proportional control plus stepping approach control mode, and the speed is controlled by the trapezoidal curve. Magnetohydrodynamic (MHD) has a certain attenuation effect on the transmission of torque. Because the driving performance of the ultrasonic motor under smaller co-directional load is studied, the load torque range is 0-0.7N.m. When applied load torque, the elastic shaft will produce torsional deformation. At the same time, the phase difference between the two signals of the gear output also changes. In high temperature environment, the mechanical characteristics of ultrasonic motor are measured. With the increase of temperature, the speed of the ultrasonic motor decreases, but the torque increases.

When testing the driving performance of motor products in vacuum tank, the traditional method is to seal and drive the motor in the tank by magnetic fluid, and to connect the motor in the tank with the equipment outside the tank axially. Machining quality control system is a part of alliance management in networked manufacturing environment. With this prototype system as the platform, we can complete the task planning, the evaluation and selection of allies, and the quality control of allies'processing. Aiming at the medium access constraint of the wireless communication network, the intelligent body node scheduling protocol is designed by using binary sequence. And the scheduling protocol is used to schedule the agent node that meets the condition to access the

network at the sampling time. Figure 2 shows the structure of the agent node.

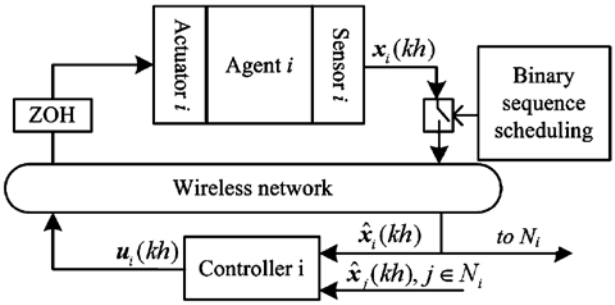

Fig. 2 Structure of the agent node

The high-precision torque sensor and the DC torque motor are placed together with the ultrasonic motor in the vacuum tank, and the value of the torque sensor is read out through the display meter outside the tank. It is the true value of the ultrasonic motor load torque, thus avoiding the measurement error caused by the torque attenuation [10]. Four pieces of resistance strain gauges are symmetrically attached to the elastic arms, and the base is directly connected with the precision rotary table, and the turntable is expanded and contracted by the piezoelectric crystal. The amount of rotation is directly applied to the measured micro-torque rod symmetrically by the upper shift fork, and the reaction force generated by the tested torsion bar can be obtained by strain measurement of the elastic member. In order to analyze the change of the output torque of the ultrasonic motor, the working mechanism of the stator of the ultrasonic motor is firstly discussed. In order to ensure the accurate reading of the torque sensor, the test accuracy will not decrease. It is necessary to adopt temperature control measures for the torque sensor. When the stator deflects, the strain beam deforms. When the original strain resistance bridge on the beam is not deformed, the output is zero. If trust is considered to be unique roughly, it will lead to overgeneralization of trust relationship. Using these generalized trust relationships to predict trust relationship will lead to imprecise trust results.

4. Conclusion

With the development of micro-ultrasonic motors, there has been a rotary ultrasonic motor with a torque of mN·m and a rotational speed of 0 to 500 r/min. This paper summarizes the current state of testing technology of micro-torque motor mechanical characteristics, and analyzes the characteristics of micro-torque measurement transmission method and balance force method. It summarizes various speed test methods and introduces the development history of test systems. The ultrasonic motor can work effectively in a vacuum high and low temperature environment, and the torque in the same direction increases as the excitation frequency is constant. The motor speed basically increases linearly, and the rotational speed is greatly improved relative to the rotational speed under normal temperature and normal pressure. By comparing the test data before and after the vacuum high and low temperature test, it can be found that the driving performance of the ultrasonic motor has changed greatly under the vacuum high and low temperature environment, and the speed of the motor has increased substantially. Researchers can select the appropriate excitation frequency through these curves, and limit the speed of the ultrasonic motor to a suitable range, so as to achieve the speed control of the stretching process of the elastic drum under the vacuum high and low temperature environment. The friction coefficient of the rotor friction material of the ultrasonic motor decreases the output speed of the motor. The increase of pre-pressure further reduces the output speed of the ultrasonic motor. Finally, the output speed of the ultrasonic motor decreases.

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