マイクロコンピューターによる超音波モータの位置制御

Form 3

Abstract

Title

Microcomputer-based Position Control Strategies of Ultrasonic Motors

(マイクロコンピューターによる超音波モータの位置制御)

In recent years, Ultrasonic Motors (USMs) have been gaining much attention as owning excellent characteristics and operating performances: high torque at low speed, high torque to weight ratio, fast and accurate speed response, holding torque without power supply, good start-stop dynamics, simple mechanical design, small in size and no electromagnetic noise. The USMs are therefore much expecting to be applied to robot actuators, high precision positioning devices and medical equipment's.

The USMs use ultrasonic vibrations from a piezoelectric material to produce a rotating motion. They are powered by two sinusoidal voltages and their control signals generally are the voltages amplitude, frequency and the phase difference between the two voltages. The operating principle of USMs have complicated speed characteristics compared to conventional electromagnetic motors which makes it very difficult to control motor speed as well as motor position. Hence, applications of the USM are significantly restricted with those drawbacks.

This research is focused on developing position controllers of traveling-wave ultrasonic motors to overcome the above-mentioned drawbacks. The main concentration is on control method using frequency and phase difference between the two supplied voltages to the motor.

When applying a load torque to an USM, a dead-zone occurs in the control input. Position controllers, which consider dead-zone, are consequently proposed for the motor. To implement the proposed control schemes, a SH7125 microcomputer with an embedded system are employed. The state quantities, such as acceleration, speed and position are required to apply digital implementation. However, a RP-442Z rotary encoder, which is used to measure the system output for feedback, causes quantization errors in the speed information. To overcome these problems, a Variable Structure System observer with the possibility of decreasing quantization error is also presented.

In other words, small, low cost and fast responsive position controllers have been designed by using a SH7125 microcomputer. Effectiveness and reliability of the proposed methods are experimentally verified, showing very good results.

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