The Hybrid Servo

In terms of their basic operation, the step motor and the brushless servo motor are identical. They each have a rotating magnet system and a wound stator. The only difference is that one has more poles than the other, typically two or three pole-pairs in the brushless servo and 50 in the stepper. You could use a brushless servo as a stepper – not a very good one, since the step angle would be large. But by the same token, you can also use a stepper as a brushless servo by fitting a feedback device to perform the commutation. Hence the "hybrid servo", so called because it is based on a hybrid step motor (Fig. 1.44). These have also been dubbed 'stepping servos' and 'closed-loop steppers'. We prefer not to use the term 'stepper' at all since such a servo exhibits none of the operating characteristics of a step motor.

The hybrid servo is driven in precisely the same fashion as the brushless motor. A two-phase drive provides sine and cosine current waveforms in response to signals from the feedback device. This device may be an optical encoder or a resolver. Since the motor has 50 pole pairs, there will be 50 electrical cycles per revolution. This conveniently permits a 50-cycle resolver to be constructed from the same rotor and stator laminations as the motor itself.

A hybrid servo generates approximately the same torque output as the equivalent step motor, assuming the same drive current and supply voltage. However, the full torque capability of the motor can be utilized since the system is operating in a closed loop (with an open-loop step motor, it is always necessary to allow an adequate torque margin). The hybrid servo system will be more expensive than the equivalent step motor systems, but less costly than a brushless servo. As with the step motor, continuous operation at high speed is not recommended since the high pole count results in greater iron losses at high speeds. A hybrid servo also tends to run quieter and cooler than its step motor counterpart; since it is a true servo, power is only consumed when torque is required and normally no current will flow at standstill. Low-speed smoothness is vastly improved over the open-loop full step motor.

It is worth noting that the hybrid servo is entirely different from the open-loop step motor operated in 'closed loop' or 'position tracking' mode. In position tracking mode, an encoder measures the load movement and final positioning is determined by encoder feedback. While this technique can provide high positioning accuracy and eliminates undetected position loss, it does not allow full torque utilization, improve smoothness or reduce motor heating.

Fig. 1.44 Hybrid servo motor with resolver feedback