

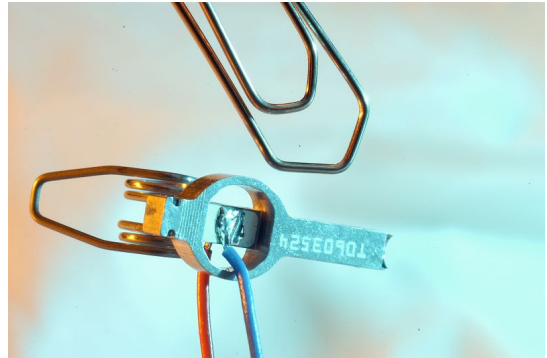
Motor & Fans: Piezo Precision

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In applications, where DC or stepper motors would be technically difficult to implement or too costly, a new piezoelectric motor may provide the right power solution in applications where a high degree of precision is desired.

A 1.2-g noiseless, gearless piezoelectric motor and actuator from Elliptec, Dortmund, Germany, provides two advantages over the other technologies – a significantly smaller size and extremely rapid speed.

Piezoelectric motors are based on the piezoelectric effect, discovered by Pierre Curie in 1883. The effect occurs in certain crystals, for example, quartz and Rochelle salt, and ceramic materials. The materials generate a voltage when subjected to pressure and conversely, undergo mechanical stress when subjected to an electric field.



Compact Elliptec Motor costs significantly less than alternatives, while delivering precise, noiseless operation.

The Elliptec piezoelectric motor can operate at voltages as low as 7V, and is the only piezoelectric motor that achieves forward and backward motion using a single piezo element and two wires. Most of its market counterparts require at least two piezo elements to achieve this. Due to its optimized construction and production, the Elliptec Motor is one-tenth the cost of its competitors.

It is the structure of the piezo ceramic that allows the motor to function at such low voltages. In instances where the piezo ceramic is placed between two electrodes, a high voltage is required. The piezo ceramic of the Elliptec Motor uses a sandwich structure, dividing the voltage.

Most conventional electric motors are operated by a magnetic field and have a rotation axle. The Elliptec Motor, on the other hand, operates on the basis of a subtle driven movement during which the driven element is moved in thousands of small steps.

These steps are produced by a key-shaped aluminium frame resonator that oscillates upon being activated by the piezo ceramic that is applied an AC voltage with a frequency of 100 kHz. The piezo ceramic expands 0.1 percent of its dimension when a voltage is applied and contracts to its original shape after the voltage is removed.

The expansions and contractions of the piezo ceramic create vibrations in the resonator, which in turn creates an elliptical movement at the tip of the resonator. It is the elliptical motion of the tip that drives the element, which can be the edge of a wheel or the surface of a linear slider, allowing the motor to deliver either rotary or linear motion.

A steel spring attached to the motor pushes the vibrating top of the resonator against the driven element, and a spring maintains a steady pressure between the resonator and driven element. With each ellipse at the top of the resonator, the driven element will be pushed either forward or backward with a speed of up to 300 mm per sec. The drive creates forces of 0.2 N to 0.4 N.

The gearless design of the Elliptec Motor allows it to be effective in applications with little installation space, where a gear would be too cumbersome. At just 20 mm x 8 mm x 3 mm, the motor starts extremely quickly and can be stopped quickly again, which is not possible with a conventional drive.

Temperature, humidity, vibration and extreme magnetic fields do not affect the performance of the Elliptec Motor. All of the materials in the Elliptec Motor are non-magnetic. The spring is stainless steel and the frame is aluminium. Because the motor works without a commutator, it does not produce sparks, nor does it emit electromagnetic interference.

Because the Elliptec Motor operates at ultrasonic frequencies, it is almost inaudible. The motor does, nevertheless, accelerate and stop its resonator instantaneously, and this sudden transition may be heard. To alleviate this problem, the control software is adjusted to more smoothly accelerate and brake the motor by varying the pulse width of the driving signal from 0 percent to 50 percent.

The PWM signal that drives the motor can also be modulated to provide audio reproduction, such as music or recorded voice. In such applications, the driven element would be a speaker membrane.

In designing motion control applications, it is important to note that the motor's driven element can only move if the friction losses in the bearings are less than the friction at the motor tip, consequently the mechanics of the system should be designed for low friction. Anti-friction bearings can be used for this purpose in linear applications. These include balls made from plastics, steel or glass as well as rollers with needles.

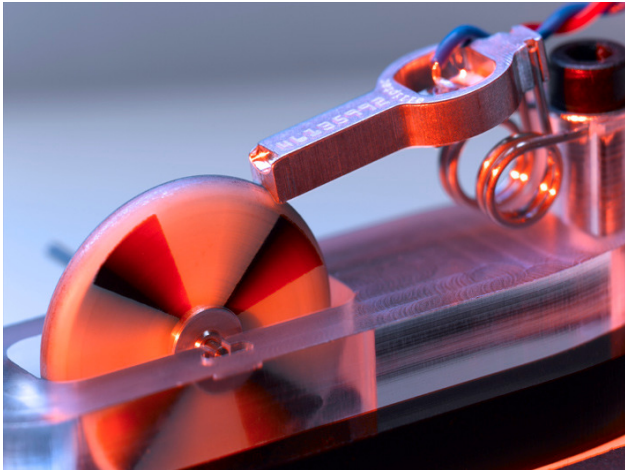
When the motor is driving a wheel or cam, utilizing a small diameter wheel axle assists in reducing friction. In extreme cases, the axle end can be tapered for tip support and for minimal friction. Larger wheels that produce higher torques can also be used to overcome friction.

Another way to add more power to the system is to simply employ additional motors working in unison. This approach can create more noise, which can be reduced by individually mounting each motor.

Gears also may be incorporated. Typically only a single stage gear is required, but multistage gears may be used to further boost motor torque. Fast gears can be eliminated in order to ensure that the motor is virtually noise-free.

Because the piezoelectric effect works both ways, the motor can also be used as a sensor in addition to acting as an actuator. In such cases, the unpowered Elliptec Motor senses when the driven element is externally pushed or pulled. The force on the piezo element causes it to generate a voltage of up to 0.3 V in response. The controller can determine if the motor is being blocked and correspondingly react, for example, stopping the motor or reversing it. Manual actuation is possible due to the integrated friction clutch of the Elliptec Motor. The sensory capabilities of the motor indicate to the controller if a user is manually overriding the motor function.

Innovative applications



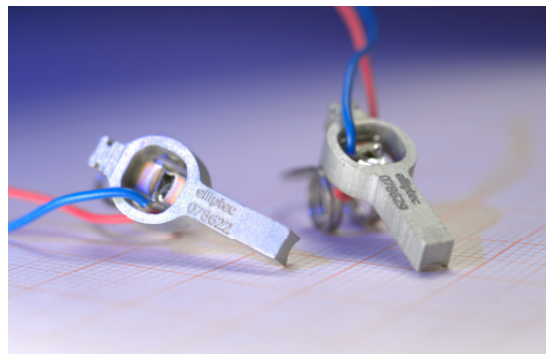
Elliptec Motor as rotor drive

Due to its precision, noiseless operation and minimal construction volume, the motor is also suited for medical applications, such as dosing devices. The drive does not store mechanical energy, so the motor can be stopped in a matter of microseconds, where conventional systems continue to run after being switched off.

In HVAC equipment the Elliptec Motor can be used to electronically actuate flaps and control airflow into a room to create individualized climate zones. The Elliptec Motor is also appropriate in vending applications for coin recognition. The motor triggers the opening of a flap inside the coin receipt in 15 milliseconds.

The Elliptec Motor has a variety of consumer electronic applications where manufacturers are seeking lower-priced, faster, lighter and more flexible designs that can benefit from a more compact motion control component. The Elliptecmotor has very low inertia, making it extremely responsive for producing quick focusing and zoom times in camera applications. Very precise positioning further enhances the quality of the end product.

The small size of the Elliptecmotor allows for a compact system design that can be integrated into a variety of applications, including providing the power to open and close CD and DVD trays, where the Elliptecmotor pushes a linear slider. The motor is also being used in rear projection televisions. In this application, a small mirror is tilted 60 times per sec. to ove the entire picture up by half a pixel, resulting in a higher resolution. The motor's stroke is limited to a couple of micrometers.



Elliptec Motor operates on the basis of a subtle driven movement during which the driven element is moved in thousands of small steps.

The typical mechanism used to open or close the small flaps is a solenoid. Solenoids are very fast, but have the disadvantage of being large and requiring more power to achieve these speeds. The Elliptec Motor offers the option of using the flap directly as the driven element, as well as a much more compact design.

The Elliptec Motor will be used in applications where DC motors or stepper motors are difficult to incorporate, says Dirk van Vinckenroye, director marketing and sales for Elliptec. "I think what will be happening first is that manufacturers will use these innovative drive systems in applications where today's technologies like DC motors or stepper motors are technically difficult and/or very expensive to use," he says. "Especially in the appliance field where cost and innovation are the driving factors, I am sure that this low-cost piezo technology will find its entrance in many applications that will be built smaller because of the gearless principle and where fast reactions are required."

This media release can also be downloaded from: http://www.appliance-design.com/Articles/Feature_Article/ae9d88dd82398010VgnVCM100000f932a8c0

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