Motors and Drives

Linear Drives

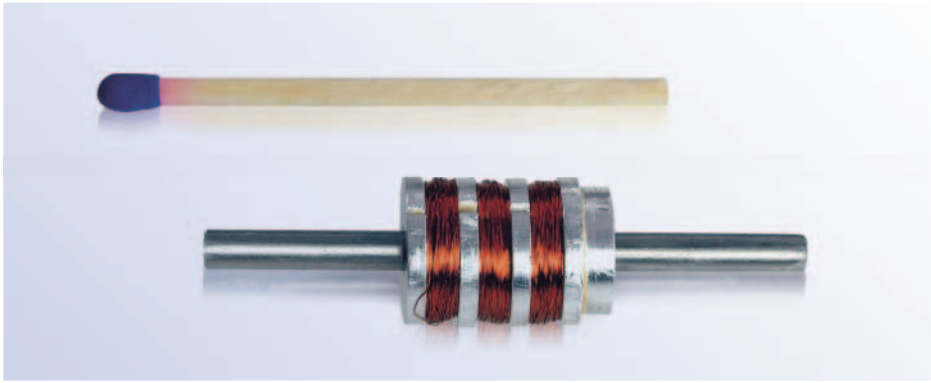
Linear drives basically allow for unlimited travel ranges. They are direct-drive systems; they do not use drive screws or gearheads and are backlash-free. The positioning accuracy of the overall system is only affected by the position measurement and the guides.

Electromagnetic Linear Drives

Linear servo motors are used both for very high and for very low feed velocities. They work precisely in a range from 0.1 µm/s to more than 5 m/s. If combined with air bearings, a position resolution down to a few nanometers is possible.

Voice-Coil Linear Drives

These friction-free electromagnetic linear drives are characterized by their good dynamics, albeit with relatively low holding force. They are used primarily in scanning applications with travel ranges from several ten millimeters. To maintain a stable position, the voice-coil linear drive, just as any other linear drive, has to be operated in closed-loop, or alternatively combined with brakes.



Very compact designs are possible with voice-coil linear drives of the PIMag series

Piezo Drives

Piezo Actuators

Piezo actuators guarantee position resolutions of less than one nanometer. Several micropositioning stage series can be supplied with additional piezo drives. As an alternative to this serial configuration, they are combined to hybrid drives, that use a common control loop for both motor and piezo actuator.

Piezo actuators can achieve extremely high accelerations of many thousand g, are frictionless and backlash-free. Normally, their travel ranges are limited to less than one millimeter.

Piezomotors: PiezoWalk®, PILine®, PIShift

Piezomotors do not generate magnetic fields nor are they affected by them. They are used for nanometer-precision-stages with long travel ranges.

Piezomotors are optimally suited for using the specific properties of piezo actuators to achieve longer travel ranges. Adapted to the required force and velocity development, PI provides a series of different piezomotor technologies, each of which focuses on different features.

Piezomotor Properties

- Self-locking when powered off with maximum holding force
- Scalable travel ranges
- Nanometer-precision resolution
- Easy mechanical integration
- Different technologies optimized for high velocities or for high forces

PI Piezomotors Compared to Piezo Actuators

Piezo flexure or stack actuators	PiezoWalk® piezo stepping drive	PILine® ultrasonic piezomotor	PIShift piezo inertia drive
Sub-nanometer resolution	Sub-nanometer resolution	Sub-micrometer resolution	Sub-nanometer resolution
Fast response within a few microseconds	Velocity up to 10 mm/s High-dynamics scan mode	Very high operating frequency Noiseless drive High velocity of up to several 100 mm/s	Very high operating frequency Noiseless drive Velocity of more than 10 mm/s
Travel ranges of up to approx. 300 µm directly and 2 mm with lever amplification	Long travel ranges, only limited by the runner length	Long travel ranges, only limited by the runner length	Long travel ranges, only limited by the runner length
High stiffness Force generation of up to 100 kN	Very high forces of up to 800 N (NEXLINE®) Self-locking at rest	Forces up to 40 N Self-locking at rest	Forces up to 10 N Self-locking at rest
Control via analog voltage Voltage range 150 V (PICMA® multilayer actuators), 1 100 V (PICA high-load actuators)	Multi-actuator drive generates stepping motion Voltage range 55 V (NEXACT®), 500 V (NEXLINE®)	Single-actuator drive Control via high-frequency alternating voltage (sinus) Voltage range 120 V, 200 V. Mini-motors substantially lower	Single-actuator drive Control via high-frequency alternating voltage (modified sawtooth) Voltage range <48 V
Ideal for:			
■ Nanometer-precise positioning with high dynamics ■ Lever-amplified and guided systems ■ Piezo scanners ■ Fine adjustment ■ Force generation ■ Active vibration insulation	■ Nanometer-precision positioning ■ Quasi-static applications at high holding force ■ Travel ranges of up to a few mm ■ Coarse and fine adjustment ■ Force generation ■ Active vibration insulation ■ Operation at constant, low velocity	■ Positioning with sub-µm accuracy ■ Fast step-and-settle ■ Scan mode with high velocities ■ Operation at constant low, velocity	■ Nanometer-precision positioning stable over a prolonged period ■ Quasi-static applications at low to medium holding force

Rotating Electric Motors

DC Motor / Servo Motor

A DC motor with position measurement is called servo motor. The typical characteristics of DC servo motors are uniform, vibration-free operation, a large velocity range and high torques at low velocity. To benefit in a best possible way from these properties, a motor controller with proportional, integral and differential control (PID) and suitable filters is required. The servo motor has numerous advantages, such as good dynamics, fast addressing, high torques at low velocities, reduced heat generation and low vibration.

DC servo motors require an operating voltage of up to 12 VDC. The rotational velocity of the motor is directly proportional to the voltage; the sign determines the direction. Repeatable positioning requires an additional position feedback system.

Brushless DC Motor

PI uses more and more electronically commuted, brushless DC motors. Optimized hollow shaft or torque motors achieve high torques. At the same time, the drive train can be shorter for the same travel range because the drive shaft is located inside the motor.

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