



Focus on the Eye

PIEZO-BASED NANOPositionING SYSTEMS FOR
LASER BEAM STEERING IN OPHTHALMOLOGY

Focusing and Control of Laser Beams

Highest Precision in the Human Eye

Piezo-based drives are fast, reliable and compact. The use of piezo tip/tilt mirror systems and precision positioning stages with piezomotors guarantees the accuracy required for the refractive correction of visual acuity. Their positioning performance makes it possible to control or focus laser beams precisely and reliably.

What do piezoceramic drives offer?

- High dynamics – fast response time
- High resolution – precise positioning
- High reliability
- Compact design – easier integration in existing laser systems

Precision positioning for highly sensitive applications in medical technology

Experience, knowledge and technological excellence are essential in medical technology to treat patients safely and reliably with state-of-the-art methods. Over the last four decades, PI (Physik Instrumente) with headquarters in Karlsruhe, Germany, has developed into the leading manufacturer of nano- and micropositioning systems. The spectrum goes from precision positioning solutions to simple drive components which are compact, fast, reliable and energy-saving. The highly sensitive applications in medical technology benefit from piezo-based drives which are integrated by PI in many different ways. Since the required piezoelectric ceramics are de-

veloped and manufactured by its subsidiary PI Ceramic, PI can flexibly meet customer requirements: From the piezoceramic disk for generating ultrasound through to six-axis positioning systems for load positioning in strong magnetic fields.

Piezo technology for reliability, safety and progress in medical engineering:

- Clinical research and diagnostics
- Microscopy and therapeutic applications
- Pumping and dosing
- Analysis of samples

Piezo-driven tip/tilt mirror systems for laser beam control

Tip/tilt mirrors are ideal for precise laser beam control for applications in the human eye. Piezo actuators are the driving force behind these one-, two- or three-axis systems. They act on the mirror platform directly or via flexure joints. Since no intermediate elements such as drive screws or gearheads are used, they are backlash-free. Multi-axis tip/tilt mirror systems are designed as parallel-kinematics, where all actuators act on the same motion platform. Thus there is only one common pivot point, which is the significant difference to single-axis systems switched in succession, e. g. galvanoscanners. The dynamics of the parallel kinematics are higher and the size is smaller. Integrated high-resolution position sensors ensure high linearity values of better than 0.25% over the full travel range and a high repeatability.

- Extremely fast response time to 1 ms and scanning frequencies of several 100 Hz
- Optical deflection angle approx. 10° with a high resolution in the microdegree range



S-334 miniature tip/tilt mirror: Compact with dimensions of 38 mm length and 12 mm diameter of the mirror

Micro linear stages with ultrasonic piezomotors for focusing

Focusing the laser beam is performed by precision positioning stages with ceramic PLine® ultrasonic motors. The drives offer extremely high velocity and acceleration with very compact dimensions. The patented drive principle makes them self-locking when at rest.

- PLine® piezo ultrasonic drive
- Direct-measuring principle: High linearity and repeatability
- Compact design



The M-663 PLine® micro positioning stage achieves velocities of up to several 100 mm/s and travel ranges up to several 10 mm. Measuring only 15 mm x 30 mm x 35 mm, the stage can easily be integrated in almost any application



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