



MPS PRODUCTS FOR OPTICS & PHOTONICS APPLICATIONS

INTRODUCTION

MPS Microsystems develops and manufactures high precision, high-performance and very efficient electro-mechanical microsystems. Managing the miniaturization and integration of functions in small spaces, MPS Microsystems provides solutions perfectly suited to specific customer requirements. MPS Microsystems also offers a standard and scalable range of products, such as linear bearings and ball screws.

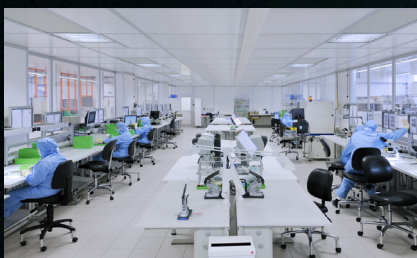
MPS's strengths particularly appreciated by its customers are:

- Innovative and reliable solutions
- Performance and miniaturization
- High quality service
- Trusted relationship



Located in Bienne, Switzerland, in a modern and well-equipped facility MPS Microsystems offers its 220 employees an exceptional working environment and offers its customers a sustainable competitive advantage in their market.

MPS belongs to the Faulhaber Group, the German manufacturer of micromotors (www.faulhaber.com).



Clean room assembly



Component manufacturing

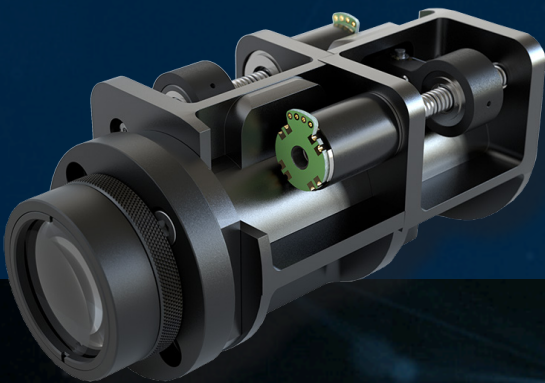
SOLUTIONS FOR OPTICS & PHOTONICS INDUSTRY

OPTOMECHANICAL SYSTEMS

A major challenge faced in the realization of high performance optical devices with mobile elements is the requirement for perfectly smooth and collinear movements ensuring the successful transposition of complex software optimizations in real optical functions.

Actuator technology platform with elimination of lens misalignment

To answer that issue MPS has created a technology platform for optical applications that shows very accurate axis displacements combined with very long lifetime. The precise relative positioning between two mobile lens groups moving on the same axis and the perpendicularity of a few tenth of a degree with the machine interfaces is achieved with shortest stack-up and MPS specific micro assembly skills (see below "Micro assembly").



In the proposed solution, the precision needed in term of concentricity and perpendicularity is performed in only one component, which geometry is machined during the same manufacturing process.

This technology can easily be customized to very different sizes and specifications. The geometry tested so far is reaching the following specifications (per lens):

- Stroke: 7.5 mm
- Z- Pos. unidirectional repeatability: $\pm 5 \mu\text{m}$
- Lateral deviation repeatability: $\pm 1 \mu\text{m}$
- Lens holder tilts repeatability: $\pm 0.1 \text{ mrad}$

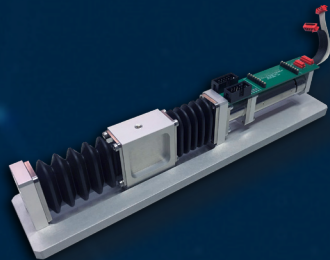
Possible technology customization:

- Additional mounting of 1" optical elements using specific adapters
- Single lens design
- Scaling lens strokes and diameters upon request
- Improved lens Z-positioning repeatability to $\pm 1 \mu\text{m}$
- Motor selection related to frequency, speed and acceleration requirements
- Cam or linear ball screw drive mechanism regarding the needed stroke and resolution
- Cost vs Resolution, proposing the system in open loop with a homing sensor

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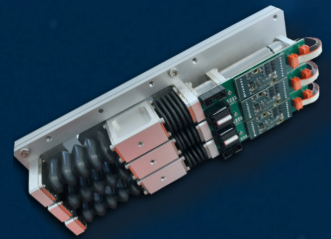
Particle free laser focus mechanisms

For high power laser machining applications requiring longer strokes and clean environment, MPS has developed a hermetically sealed linear actuator. In this case, the drive system is based on a 22 mm brushless DC motor coupled to a Ø4 mm ball screw. MPS L-510X linear bearings insure smooth and play free movement of the carriage, on which the lens holder is accurately fixed. In order to protect the optics from smallest particulates generated by the tiny wear of the system, the guiding as well as the screw drive mechanism are completely sealed by two bellows. In the purpose of giving the closest answer to customer requirements, the lens holder shape and size are adapted to the dimension of the required lens obtained in optical simulations.



This technology can easily be customized to very different sizes and specifications. The geometry tested so far for one actuator is reaching the following specifications (per lens):

- Stroke: 40 mm
- Z- Pos. bidirectional repeatability: $\pm 5.5 \mu\text{m}$
- Lateral deviation repeatability: $\pm 4.5 \mu\text{m}$
- Lens holder tilts repeatability: $\pm 0.1 \text{ mrad}$
- Cost vs Resolution, proposing the system in open loop with a homing sensor

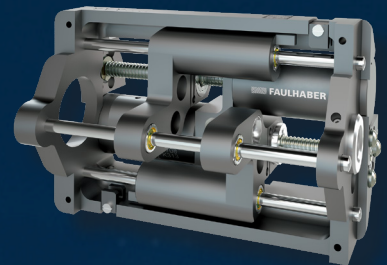


Configurable multi-purpose zoom mechanism

Focusing a laser over a distance of several kilometers or moving lenses very accurately in imaging based stereoscopic surgical glasses require the lenses to remain coaxial with no tilting over long strokes of 50 mm or more. For this purpose, MPS has developed a scalable zoom platform that can accommodate 1-4 movable groups of lenses depending on customer requirements. The stroke as well as the size of the lenses can be adjusted and though the size of the system optimized.

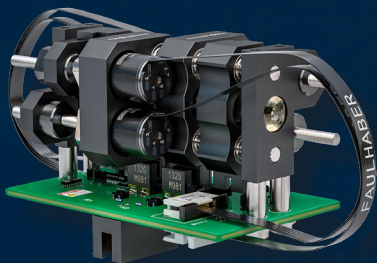


Not only smart and elegant, the design has been strongly optimized in width to allow stackable configurations and bring the possibility to easily build more complex optical functions. The illustrations below show a typical assembly of several actuators with adapted lens holders allowing focusing and magnification functions of a laser beam.



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The system is driven by standard stepper or BLDC micromotors coupled with either ground lead screw or high precision MPS ball screws. MPS is using its own miniature L-Type linear ball bearing for smooth and play free guiding. High precision requirements are put on the frame, which has to ensure perfect perpendicularity between lenses and z-axis axis during any movement. The linear positioning resolution is 1 μm over the full stroke.



Ophtalmology

Eye tomography as well as cataract and refractive surgery require the focus of the laser beam to be very precise. MPS has developed high-precision miniature lens actuators for manufacturers of ophthalmic devices. These actuators consist of a 6 mm micro motor, a pre-loaded screw-nut system and a linear guideway.

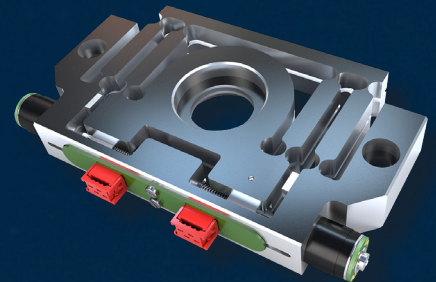
The system is designed in such a way that it is able to compensate for the imperfection of axes alignment. The most stringent requirement is to find the 0 position with a precision of 1 μm between each measurement.

Microscopy

Eye tomography as well as cataract and refractive surgery Microscopic observation of three-dimensional samples can be a challenge when moving the objective in the z-axis close to the sample: the risk of touching and destroying it is significant. MPS has developed a backlash-free, flexure elements based system, which moves 2 lenses laterally in order to make the fine focus and though eliminate the risk of contact with the sample.

The system with a full stroke of 2.5 mm is driven in open loop by 2 stepper motors attached to a miniature lead screw. Light barriers set the home position at the beginning of each operation. The position repeatability is below 2 microns.

The simplicity of the system makes it very reliable, easy to connect and affordable.



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Optical fiber positioner for Astronomical Observation

Research in the field of dark matter is leading to the development of new equipment that enable the collection and analysis of light emitted by distant galaxies. In partnership with a research group, MPS has developed and is manufacturing a number of high precision, reliable systems for positioning optical fiber directed towards these galaxies. Thousands of these positioners are installed in the focal plane of telescopes.

With a diameter of less than 10 mm, the positioner must be able to accommodate two parallel axes that rotate independently the optical fiber with two 4 mm Faulhaber gearmotors.

MPS is the leader in providing the Astronomy Research Community with positioners and has already realised three projects, for which positioners are installed or will soon be installed on three telescopes around the world (Very Large



Telescope, Sloan Foundation 2.5 m Telescope at Apache Point Observatory, Irénée du Pont Telescope at Las Campanas Observatory).

An easily scalable positioner platform is available at MPS for any organisation needing such systems.



Miniature test bench with six degrees of freedom

MPS is in the process of developing a miniature mechanism with six degrees of freedom (6DOF): X, Y, Z, Roll, Pitch and Yaw. The system is based on the principle of serial kinematics and modular: one DOF can be easily removed or added depending on customer requirements. The system can be designed very small (60 x 50 x 32 mm) but is scalable to bigger size if the test bench needs to move large or heavy objects. The system is smaller, more flexible and significantly easier to drive than hexapods. Regarding accuracy, positioning repeatability of 1 micron is achievable. This system is ideal for quality inspection of consumer electronic devices such as smartphones, tablets and laptops.

MPS COMPETENCES

RESEARCH & DEVELOPMENT

The high level of training and experience of its micro-mechanics engineers allows MPS to quickly develop innovative solutions that meet the needs of its customers. Our developments and documentation meet the international standards of the medical market.

Fully equipped, the prototyping workshop guarantees the production and modification of rapid prototypes, free from the logistical constraints of mass production. The equipment includes lathes, milling machines, wire erosion machines and grinding machines.

The test laboratory equipment is used to carry out service life tests for systems developed by MPS, noise measurements, traction tests, torque measurements and simple measurement systems.

MANUFACTURING (precision as a key value of MPS)



The turning & milling workshop has a series of CNC and EDM machines. Each work bench is equipped with measuring instruments for controlling, at any time, the quality of the products manufactured.

Acquired over many decades, MPS's heat treatment knowledge is essential to achieve the material properties needed for the performance of the systems manufactured. MPS also has expertise in deburring and washing components.

MPS sets itself apart thanks to its grinding and polishing expertise. In these workshops, components achieve dimensional precision of less than one micron, through centerless grinding, external / internal diameter grinding, and mirror surface finishes ($Ra < 0.1 \mu m$). All MPS ball screws have threads that are grinded on latest-generation equipment.



MPS manufactures high quality (ISO grade 3) miniature stainless steel and ceramic (zirconium oxide) balls with diameters between 0.130 mm and 1.588 mm.



MPS COMPETENCES

MICRO ASSEMBLY

MPS specialises in the micro-assembly of complex systems which require specialist knowledge and specific expertise.



The size of parts and the required precision necessitate a controlled atmosphere in the entire assembly workshop, with continual air change and filtration. A clean room ISO 7 is

available for implantable medical applications.

Our main skills include the assembly of micro-components, laser welding, laser marking, gluing, precision lubrication, washing and pairing, enabling adjustments of less than 0.2 µm.

The workshop is organised according to «lean manufacturing» principles. Dedicated cells are set up when necessary.



QUALITY

The MPS Quality department ensures the continuation of certification : ISO 9001 - ISO 1348 - ISO 14001.

In order to guarantee the delivery of products that observe legal requirements, MPS prepares the files that are essential for certifications (European Directives 93/42/EC, 90/385/EEC, 21CFRpart820, etc.) and for medical devices to be placed on the market.



PROJECT MANAGEMENT

In our project development process, customers are in close contact with a dedicated project manager who ensures close communication and coordination with the internal project team and external partners. The MPS management system integrates the project management process.



WHERE TO FIND US

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