

*Active Laser Beam Alignment*

**Description**

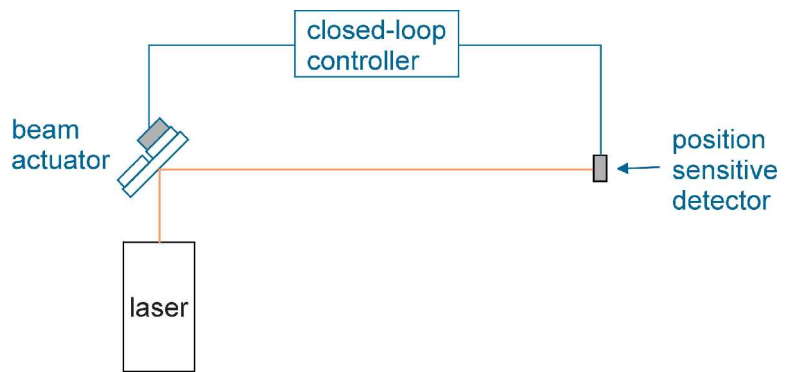
MRC offers two different systems for beam alignment, stabilization, positioning, and adjustment. The Dynamic stabilization system acts on the assumption that the desired laser beam direction is fixed.

The Self-learning system enables the adjustment of the laser beam in free space.

**Applications**

- Automated positioning of laser beams
- Fast delivery of laser beams to changing applications
- Robust and reliable laser beam alignment
- Laser beam stabilization
- Precise motion and vibration control
- Compensation of laser beam pointing
- Compensation of spatial deviations between a laser and its application

*Working principle:  
Actuated mirrors adjust the laser beam to any direction defined by position sensitive detectors*



*Setup of Dynamic beam alignment (2-mirror alignment)*

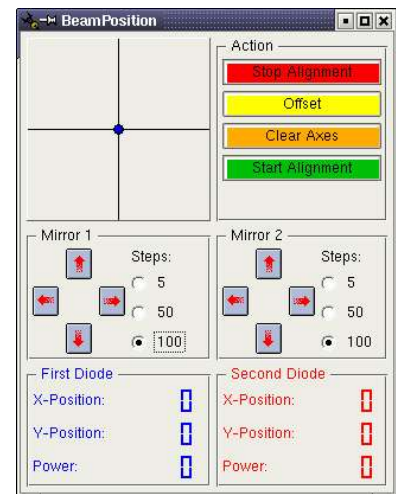


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*Display of Self-Learning beam alignment (example)*



Active Laser Beam Alignment

**Dynamic laser beam stabilization for fixed targets**

This system automatically adjusts a laser beam to a defined direction. It also levels out changes in the laser beam direction and stabilizes its position in real-time, which means an active control of internal and external vibration sources as well as fast and automated correction of laser beam misalignment or pointing.

It makes use of one or two Piezo-controlled mirror actuators and position-sensitive 4-quadrant diodes.

In the preferred set-up with one 4-quadrant-diode, the diode is located close to an application, where a stable position of the laser beam is required. By addition of a second detector and a beam shuttle, the laser beam can be delivered to a second application.

If the application is highly sensitive to angular deviations, a second Piezo-driven mirror actuator can be used.

**Self-learning laser beam positioning for moving targets**

This system is based on a micro-controller and a self learning software algorithm. The algorithm finds the orthogonal axis of the detectors enabling a fast adjustment of the laser beam by means of a standard two-mirror alignment process.

It makes use of two picomotor<sup>tm</sup>-driven mirrors and two position-sensitive 4-quadrant diodes.

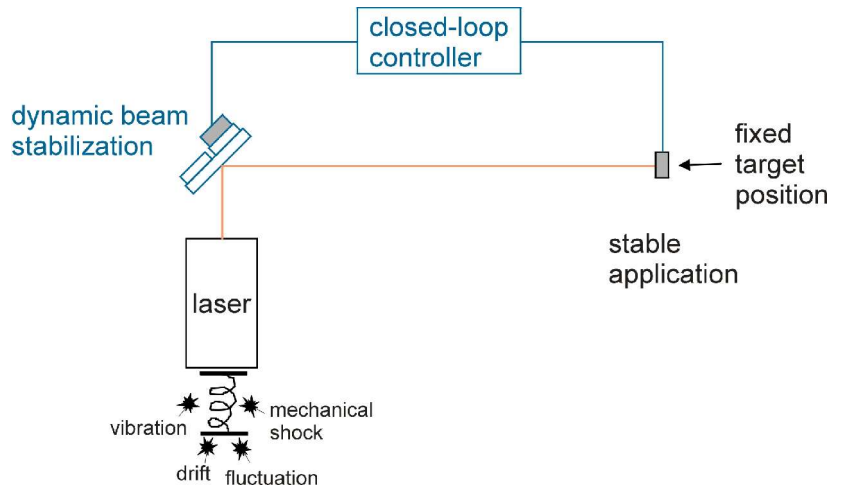
The mirrors adjust a laser beam onto any direction defined by the 4-quadrant-diodes. In a preferred setup, the diodes are directly connected to an instrument with a changing orientation in space (e.g. medical handpiece with articulated mirror arm).

The system displays the current beam position on the detectors and the beam displacement, respectively.

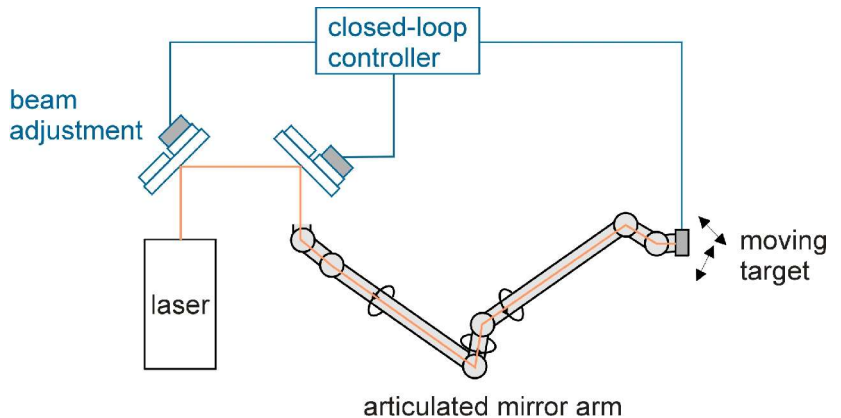
Specification	Dynamic	Self-Learning
Actuator type	Piezo actuators	Picomotors <sup>tm</sup>
Detector type	4-quadrant diode(s)	4-quadrant diodes
Adjustment Time	Realtime operation (bandwidth: up to 300 Hz)	Several minutes (depending on the laser parameters, the angular displacement between detectors and mirrors, and the desired accuracy)
Range	actuator: max. 2 mrad	actuator: > 10° (the maximum range is limited by the distance to the detectors, which must be hit)
Controller	fast analog electronics	micro-controller and software
Appropriate laser parameters	cw- and pulsed (repetition rate > 100 Hz) lasers, ultrafast lasers	
Control range and accuracy	depends on beam size and distance between mirror and detector	

**Application examples**

*Example 1:  
Compensation for laser drift.  
The Dynamic beam stabilization eliminates critical changes of laser beam direction due to vibration, mechanical shock, thermal drift, or other fluctuations of the laser output.*



*Example 2:  
Beam alignment through articulated mirror arm. The Self-Learning beam positioning determines the orientation of the target and adjusts the laser beam onto the optical axis. This setup compensates mechanical tolerances of the articulated mirror arm.*



**Common features of all systems**

- Positioning of cw- and pulsed (repetition rate > 100 Hz) lasers
- Positioning of ultrafast (ps, fs) lasers
- Control electronics can be optimised for different repetition rates
- System can be adapted for variable laser powers and wavelengths
- Closed-loop active control
- Mirror mounts can be adjusted manually for fast pre-alignment
- Flexible connectors
- Control range and accuracy depend on the beam size and the distance between mirror and detector
- OEM versions available