APPLIED SCIENTIFIC INSTRUMENTATION

Tunable Lens

About Tunable Lens

ASI's tunable lens is a versatile element for a variety of microscopy applications.

Tunable lenses can adjust the focal plane of a stationary microscope objective, replacing a focus stage. Using a bare tunable lens introduces significant optical aberrations, but combining the tunable lens with a 4f relay lens system reduces the aberrations to an acceptable level for many applications. ASI's 4f relay assembly with integrated tunable lens can be placed at the camera port of any microscope with a C-mount interface. ASI's XYZ Tracker uses a tunable lens in this manner to implement focus feedback on an auxiliary imaging path, allowing the tracker to automatically follow samples moving in Z.

Tunable lenses are commonly used in light sheet microscopy to adjust the axial position of the beam waist. In addition to being useful for system alignment and automated adjustments, some light sheet acquisition schemes translate the beam waist synchronously with the camera's rolling shutter to improve axial resolution (e.g. ASLM, Axially Swept Light Sheet Microscopy). The straightforward way to translate the beam waist is by adding a tunable lens at the entrance to the light sheet generator. ASI offers all the necessary hardware to implement ASLM, including both the tunable lens and light sheet generator.

Another application combines two tunable lenses to make an electronically-adjustable beam expander. A final use is to implement an electronically adjustable collimator for white light lasers, compensating for the fiber's wavelength-dependent divergence point.

The lens is made of an optic-quality deformable polymer manufactured by Optotune. By applying an electric current, the shape of the polymer changes. Thus, the focal length of the lens can be adjusted to a desired value within milliseconds. ASI-designed drive electronics have better performance than alternatives, and also allow tunable lenses to be easily synchronized with other microscope components.

Response time and tuning range depend on the exact tunable lens (and polymer) used; stiffer lenses are faster but have less tuning range. The standard Optotune tunable lens used by ASI has a 12 diopter tuning range and <15 ms transient response. Used with ASI's 4f relay, it produces 80 µm focus change with a 20x objective and 8 µm of focus change with a 60x objective. The tunable lens can be easily paired with an offset lens to adjust the center of the tuning range.

Applied Scientific Instrumentation Inc. | 29391 W. Enid Rd. Eugene, OR 97402
(541) 461-8181 | (800) 706-2284 | info@asiimaging.com | www.asiimaging.com

TGTLC Features

- Each card controls up to 2 tunable lenses
- Control with serial commands, manual input devices (knob or joystick), or a 0-5V analog signal
- Aliasing is reduced with an onboard 5th order filter
- For default lens: 15ms transient response, resonant frequency at 150Hz and 600Hz. Other lenses available.
- Includes compensation for temperature-induced focal shifts

Applications

- Acquire Z series by changing the focus position without moving the objective or sample
- Implement focus feedback, e.g. using ASI's XYZ Tracker Plugin in Micro-Manager
- Implement ASLM (axially swept light sheet) with ASI's cylindrical lens scanner
- Electronically-controlled beam expander
- Electronically-adjustable collimator

Part Numbers

- C60-TUNELENS-4F: 4F assembly including tunable lens and C-mount interfaces on both ends
- C60-TUNELENS-xxx: Optotune EL-10-30 lens in C60 system with compensating negative lens (various options)
- C60-TUNELENS-NC: Optotune EL-10-30 lens in C60 system, no compensating negative lens.
- C60-TUNELENS-K1: Kit to use the tunable lens with ASI's light sheet scanner
- TGTLC: TG-1000 control card for Optotune lens including temperature compensation.