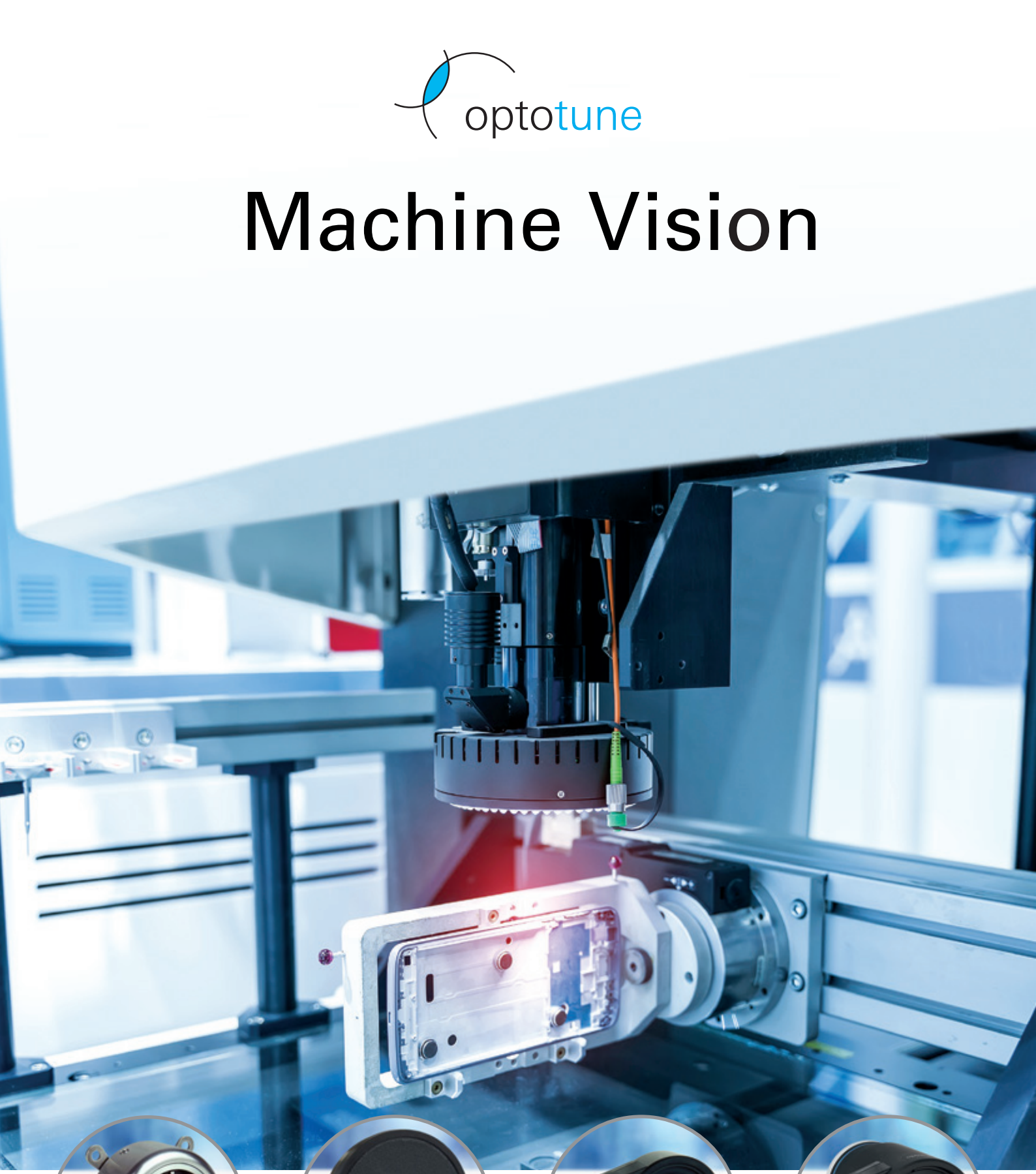
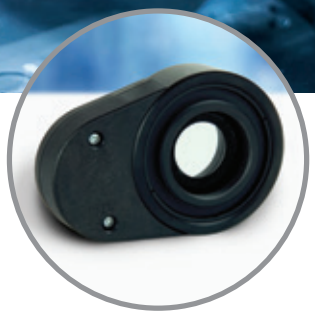
optotune

Machine Vision





Shaping the future of optics

optotune
shaping the future of optics

“Optotune’s mission is to enhance people’s lives through innovation in dynamic light control.”

“Optotune’s vision is to be the solution of choice for optical systems that need dynamic light control.”

Dr. Manuel Aschwanden
CEO

Established in Switzerland in 2008 and privately owned

28 sales partners and distributors in 30 countries

250 employees in Switzerland, Slovakia, Taiwan and Korea

More than 1 million products sold worldwide

R&D spend exceeding 25% of revenue

Industrial, medical, AR/VR and automotive markets

5000 m2 production & cleanroom capacities exceeding 300 Ku/year

Innovative award winning products

Core competences

Patented optical technology: Optotune combines optics with smart actuation techniques to enable compact and reliable solutions for dynamic light control. Thanks to our highly innovative and patented technology, our customers are able to deliver cutting-edge products across several markets.

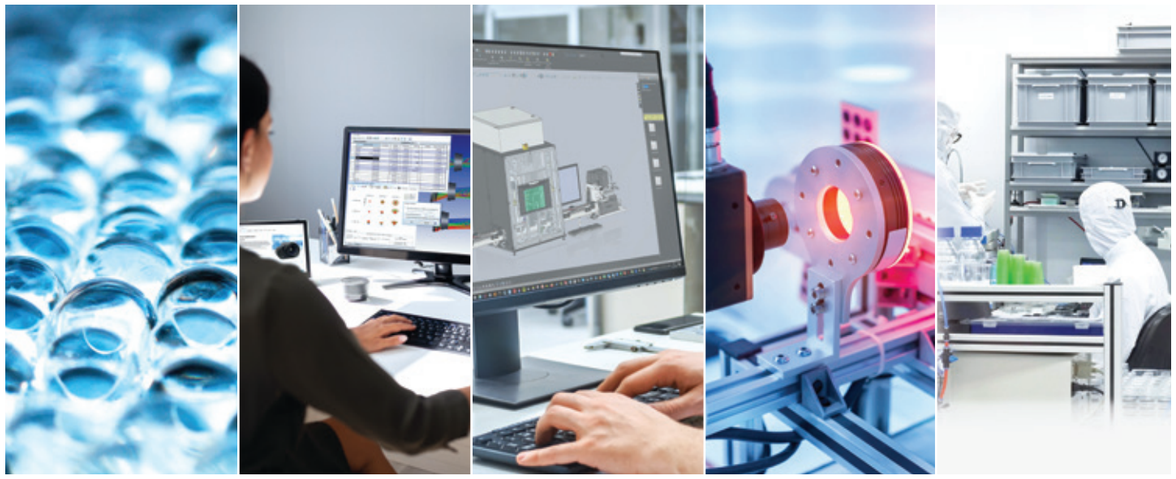
In-depth research capabilities: Optotune is continuously investing in material characterization and testing to deliver state-of-the-art products that solve the most challenging applications such as high-frequency vibration environments or ultra-portable systems.

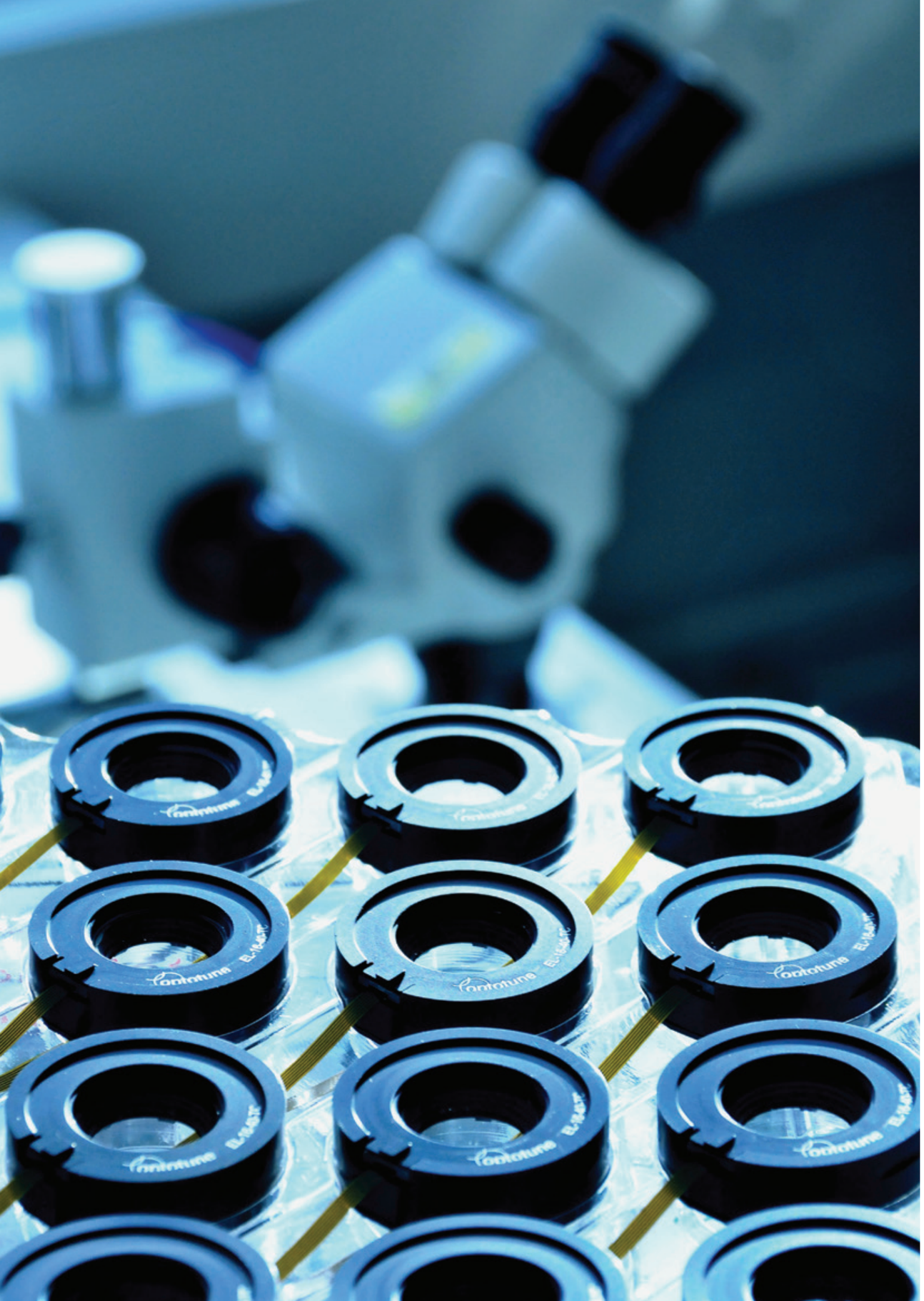
Scalable manufacturing: having different manufacturing sites at various levels of automation enables our customers to access our products with a top-class delivery performance from sampling through to mass production in class 1000 cleanrooms.

360° design skills: from optics simulation in Zemax to mechanical and electrical design to software, our R&D team enables our customers to access a one-stop-shop for our liquid lenses and optical actuators.

Application & customer support team: application diversity in fast changing markets has increased the challenge to identify the appropriate solution; our application engineering team will carry out extensive feasibility studies to select the right Optotune products to solve your challenge.

Custom design: demanding applications have often specific requirements (coatings, optical power ranges, dimensional constraints, certificates), which call for customization. Optotune’s know-how in design, manufacturing and quality assurance enables the delivery of future-proof custom products.





Liquid lenses overview

Electrically tunable lenses

Optotune provides a range of electrically tunable lenses - also known as liquid lenses - which are based on its proprietary shape-changing design to provide fast and reliable focus control.
Our ELs are available in different sizes, focal power and wavelength ranges (from 400 to 2500nm). Compact designs with FPC connection cables are available for integration into optical systems. Some models also feature industrial versions with mounting threads and robust Hirose connectors.

EL-16-40-TC with thread adapters (industrial version)

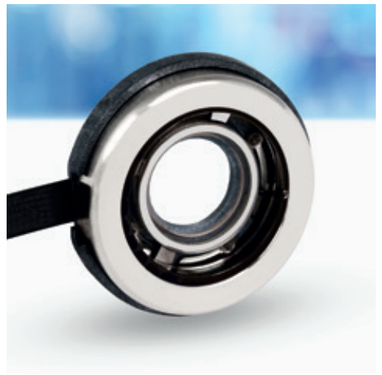
Key features:

- Response time of few milliseconds
- Low dispersion (Abbe# V>100)
- Lifetime > 1 billion cycles
- High repeatability <0.1 dpt

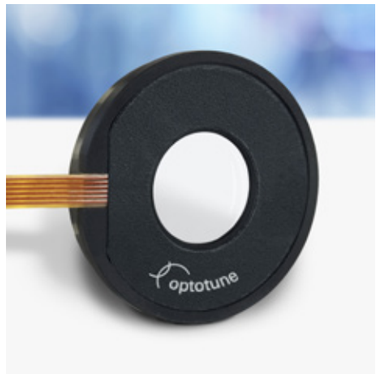
Product	Focal power range (dpt)	Clear aperture (mm)	Outer diameter (mm)	Rise / settling time (ms)	Repeatability (dpt)
EL-3-10	-13 to +13	3	10	1 / 3	N/A
EL-7-20-TC	-6 to +8	7	20	1 / 6	< 0.1
EL-12-30-TC	-6 to +10	12	30	3 / 10	< 0.1
EL-16-40-TC	-10 to +10	16	40	5 / 13	< 0.1

For detailed information about Optotune's liquid lenses, please visit www.optotune.com/focus-tunable-lenses

EL-3-10



EL-7-20-TC



EL-12-30-TC

ELM series

Optotune has co-designed with its optics partners a series of lens modules developed around its electrically tunable lenses. This results in an optically optimized and integrated solution that simplifies the design of vision systems.
Within the ELM series, there are two subcategories: fixed focal length lenses **(ELM-F series)** and telecentric lenses **(ELM-T series)**.

ELM-F series

The ELM-F series consists of fixed focal length lenses specifically designed to accommodate Optotune's electrically tunable lenses in the optical path.

The series, which is in continuous expansion, currently supports S-mount and C-mount cameras up to a sensor size of 1.1" with focal lengths ranging from 5 to 300mm.

Key features:

- Embedded lens controller available
- Low f-numbers without vignetting
- Most compact solutions

ELM-50-3.5-18-C

Product	Focal length (mm)	F#	Pixel size (um)	Camera sensor format	Mount	Manufacturer
ELM-5-5.0-7-S	5	5.0	2.2	1/2.5"	S-mount	Evetar
ELM-6-5.6-9-C	6	5.6	3.5	1/1.8"	C-mount	Opto Engineering
ELM-8-5.6-9-S	8	5.6	2.4	1/1.7"	S-mount	OPT
ELM-8-5.6-11-C	8	5.6	3.5	2/3"	C-mount	Opto Engineering
ELM-12-4.0-18-C	12	4.0	2.4	1.1"	C-mount	Optotune
ELM-12-5.6-9-S	12	5.6	2.4	1/1.7"	S-mount	OPT
ELM-16-3.1-18-C	16	3.1	2.4	1.1"	C-mount	Optotune
ELM-16-5.6-9-S	16	5.6	2.4	1/1.7"	S-mount	Opt Manchine Vision
ELM-25-3.2-18-C	25	3.2	2.4	1.1"	C-mount	Optotune
ELM-25-5.6-9-S	25	5.6	2.4	1/1.7"	S-mount	Opt Manchine Vision
ELM-35-3.2-18-C	35	3.2	2.4	1.1"	C-mount	Optotune
ELM-50-3.5-18-C	50	3.5	2.4	1.1"	C-mount	Optotune
ELM-60-4.0-24-C	60	4.0	3.5	4/3"	C-mount	Schneider
ELM-75-4.0-16-C	75	4.0	3.5	1"	C-mount	Evetar
ELM-75-4.0-8-C-NIR	75	4.0	3.45	1/2.3"	C-mount	Evetar

ELM series

ELM-T series

The ELM-T series is made of telecentric lenses designed to accommodate Optotune's electrically tunable lenses in the optical path. This optimized design preserves telecentricity and near constant magnification. Magnification change is linear with the working distance and can be easily calibrated out.

This series currently supports magnifications ranging from 0.133x up to 4x and camera sensor formats from 1/2" inch up to 35mm.

Key features:

- Image distortion-free
- No loss of resolution
- No vignetting
- Embedded lens controller available

TS1-4.0-110-EL

Product	PMAG	F#	Camera sensor format	Working distance (mm)	Mount	Manufacturer
TCZEL23056	0.18-0.55x	9 to 16	2/3"	115.0 - 155.0	C-mount	Opto Engineering
TCALP43F-0267-208	0.26x	7.5	4/3"	195.0 - 220.0	F-mount	Linkhou
TCALP1-05-110	0.50x	7.2	1"	106.0 - 122.0	C-mount	Linkhou
EO 73-701	0.75x	10	2/3"	85.0 - 99.0	C-mount	Edmund Optics
VS-THV1-110/S-LQL1	1x	10	1"	106.1 - 120.0	C-mount	VST
TCEL150 (b)	1.50x	16	2/3"	117.9 - 142.1	C-mount	Opto Engineering
VS-THV3-110/S-LQL1	2x	9.6	1"	105.4 - 115.6	C-mount	VST
TCEL250 (b)	2.50x	20	2/3"	117.8 - 142.2	C-mount	Opto Engineering
TCEL350 (b)	3.50x	24	2/3"	117.8 - 142.2	C-mount	Opto Engineering
VS-TCH4-65-LQL1	4x	17.5	2/3"	64.7 - 65.3	C-mount	VST

Selection of lenses representative of the ELM-T series, for a full list, please visit www.optotune.com/telecentric-lenses

Controllers overview

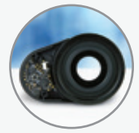
Controllers

Optotune's focus tunable lenses are controlled by current. Off-the-shelf controllers are available that provide the necessary current to the specific product and offer advanced software control options, such as temperature compensation and response time optimization.
Controllers range from compact portables, R&D development kits to 24/7 industrial operation solutions.

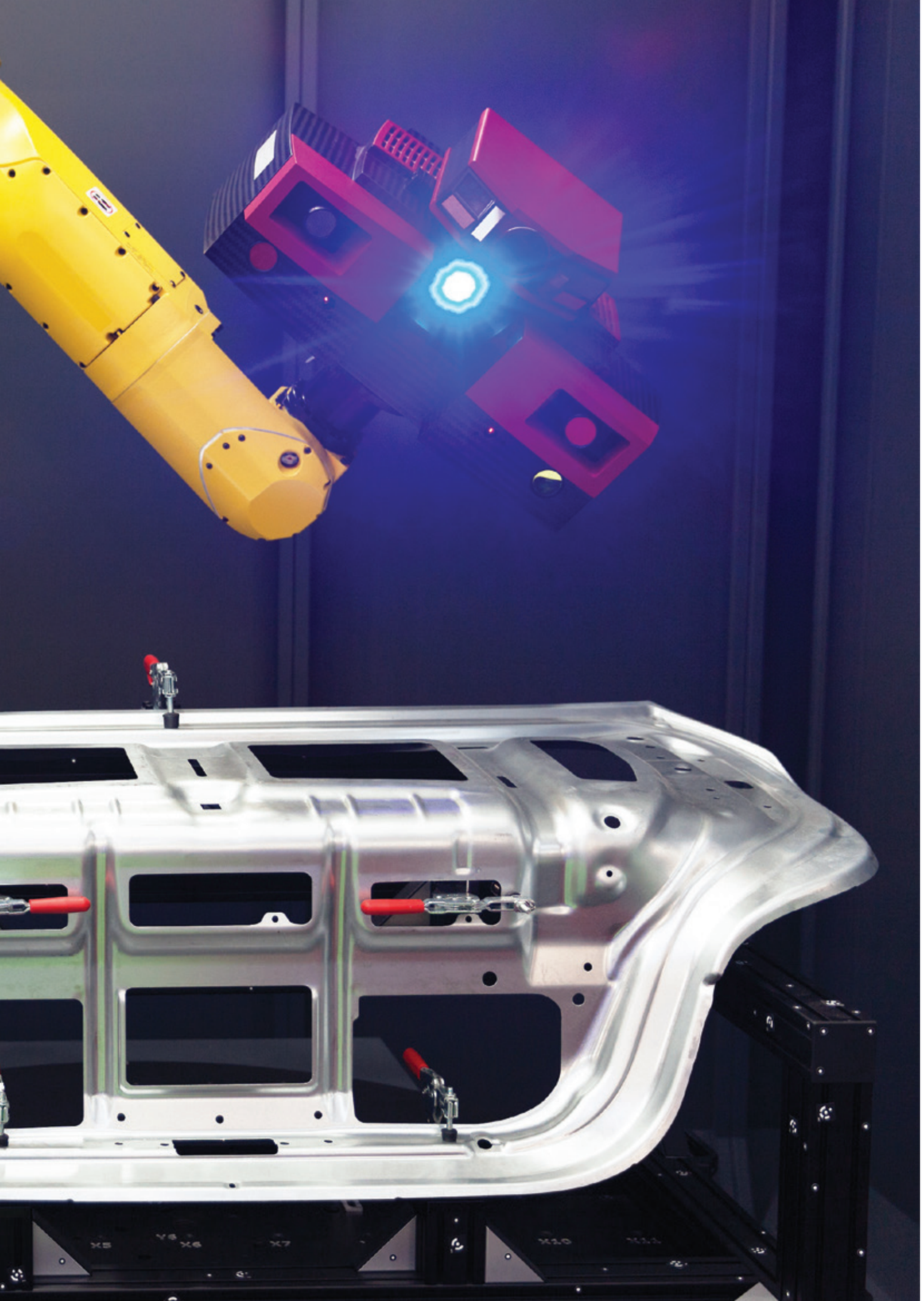
Product	EL-E-4	EL-E-4i	ECC-1C	ICC-1C	ICC-4C
					
Applications	Portable systems, R&D	Portable systems, R&D	Connect to cameras or embedded systems	Industrial 24/7 operation	Industrial 24/7 operation
Current range	-290 to + 290 mA	-290 to + 290 mA	300 to +300 mA	-500 to +500 mA	-500 to +500 mA
Interfaces	USB, UART, Analog 0-5 V	USB, UART, Analog 0-5 V	UART, I2C, Analog 0-10V, GPIO	USB, Ethernet, UART, I2C, Analog 0-10V	USB, Ethernet, UART, I2C, Analog 0-10V
SDKs	C#, LabVIEW, Python	C#, LabVIEW, Python	C#, Python	C#, Python	C#, Python
Supply voltage	5 V	5 V	5-24 V	5-48 V	24-48 V
Connection	FPC	Hirose	Hirose	Hirose Extension board	Hirose Extension kits
Channels	1	1	1	1	4
Standards	CE, RoHS	CE, RoHS	CE, RoHS	CE, RoHS	CE, RoHS

Above: The Optotune ICC-4C-500 four channel controller

Lens controller compatibility

Product	EL-E-4	EL-E-4i	ECC-1C	ICC-1C	ICC-4C
					
EL-3-10-FPC	●			⊕	⊕
EL-7-20-TC	●			⊕	⊕
EL-12-30-TC	●			⊕	⊕
EL-16-40-TC (FPC)	●		●	⊕	⊕
EL-16-40-TC (Hirose)		●		●	●
ELM-F (FPC)	●			⊕	⊕
ELM-F (Hirose)		●	●	●	●
ELM-T (Hirose)		●	●	●	●

⊕ Compatible with extension kit



Applications

Robotics inspection

The challenge:

Robots are taking more and more space within our factories and they are now used both in production and inspection processes, the necessity of fast and precise focus on the on-board vision system is becoming key to increase the throughput and reduce the yield loss due to undetected defects.

Optotune's solution:

Optotune liquid lenses with fast response time (within 20ms), high repeatability and lifetime of more than 1 billion cycles are the perfect solution for the on-board vision system of your robot to quickly change the focus of your camera sensor and enable defect detection during the inspection process. Simply move your camera closer to the object and refocus to increase the magnification!

EL product family advantages:

- Fast focus within milliseconds
- Large working distance range
- Remote focus control
- High repeatability
- Long lifetime

Applications with similar challenges:

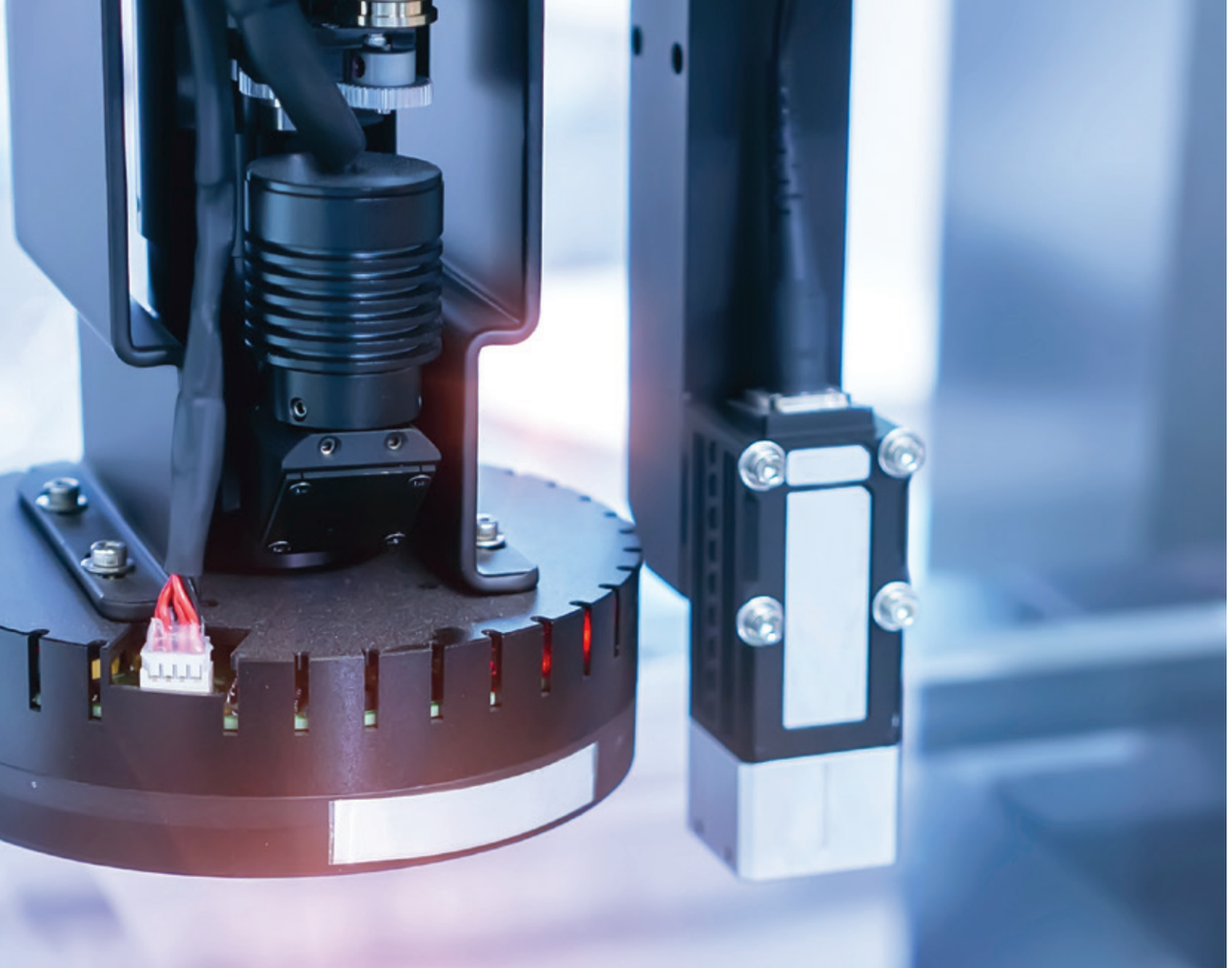
- Barcode reading
- Bottle inspection
- Package sorting

Products:

ELM-F series

EL-16-40

+ Controller



Applications

Electronics inspection

The challenge:

Electronic boards and components have to be checked via automated inspection, reference points and critical components which are often positioned in locations with different heights. The need to inspect features at different focal planes calls for either the motorized movement of the vision cell in the z axis or a change of optics.

Optotune's solution:

Optotune liquid lenses are the ideal solution to improve the performance of your inspection system thanks to the ability to increase its depth of field and provide better image quality, also avoiding the vibration generated by the motorized focus mechanism.

EL product family:

- No vibration
- Fast focus within milliseconds
- Extended depth of field
- High throughput
- Reduced cost

Applications with similar challenges:

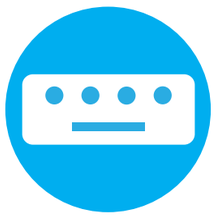
- LCD panel inspection
- Contact lens inspection
- Diamond inspection

Products:

ELM-F series

ELM-T series

EL-16-40



+ Controller

Applications

Mobile phone camera lens inspection

The challenge:

Mobile phone camera lens assemblies are difficult to inspect because of complex geometry, which does not allow to easily access the different layers. The necessity of high magnification reduces the available depth of field, which hinders the ability to fully inspect the camera modules.

Optotune's solution:

Optotune liquid lenses integrated into telecentric (ELM-T) modules enable the shift of the focal plane, which results in an extended depth of field at high magnifications. A whole stack of images can be acquired within milliseconds allowing for inspection of multiple surfaces within the same workstep.

Telecentric lenses (ELM-T) product family:

- Linear magnification change
- 3D image stacking
- Linear, repeatable magnification change
- Long lifetime

Applications with similar challenges:

- Glass inspection
- Particle counting

Products:

ELM-T series

+ Controller

Applications

Supermarket robots

The challenge:

Supermarket robots are quickly increasing their presence in stores to enable the continuous verification of in-store stock to replenish missing items; in order to do that the onboard vision system has to be able to scan barcodes at different distances and heights. It is a challenge to provide enough resolution without compromising the working distance range and the field of view.

Optotune's solution:

Optotune liquid lenses integrated into a fixed focal length module are the perfect solution to focus quickly and reliably across a large working distance range, while maintaining a low F#. Our ELM-F series is optimized for the best optical performance at minimal size, weight, and cost.

ELMs product family:

- Compactness
- Large working distance range despite low F#
- Fast focus
- Long lifetime

Applications with similar challenges:

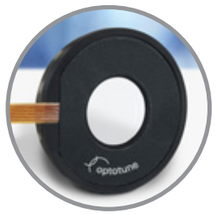
- Drones
- Iris recognition
- Logistics robots

Products:

ELM-F series

EL-3-10

EL-16-40



EL-12-30

+ Controller

Working principle and advantages

Focus tunable lenses

Traditional optics are focused through a mechanical movement of the lens module, which is adjusted depending on the object distance. This presents several downsides:

- Limited focusing speed
- Need for a motor to change focus, which increases size and complexity
- High maintenance and calibration cost
- Limited cycle life due to wear and tear of mechanics

Optotune's proprietary focus tunable lenses overcome the limitations of traditional lenses and deliver the state-of-the-art solution to solve vision applications that require fast focusing.

Key advantages

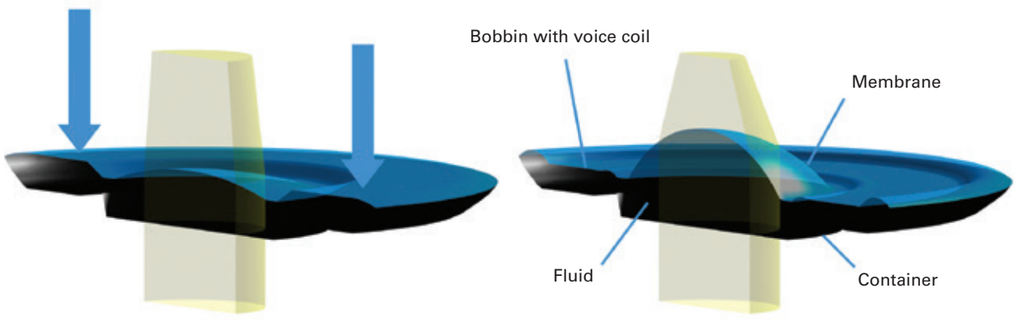
The key advantages of this technology compared to traditional optics are:

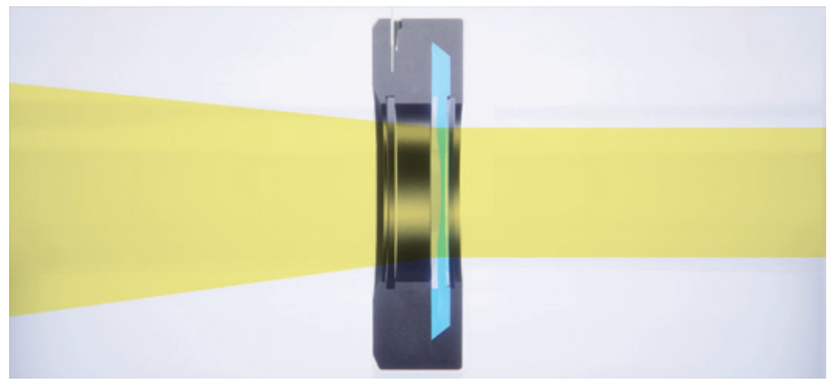
- Fast-focusing speed in few milliseconds
- Compact and robust design
- High reliability (more than a billion cycles)
- Cost-effectiveness

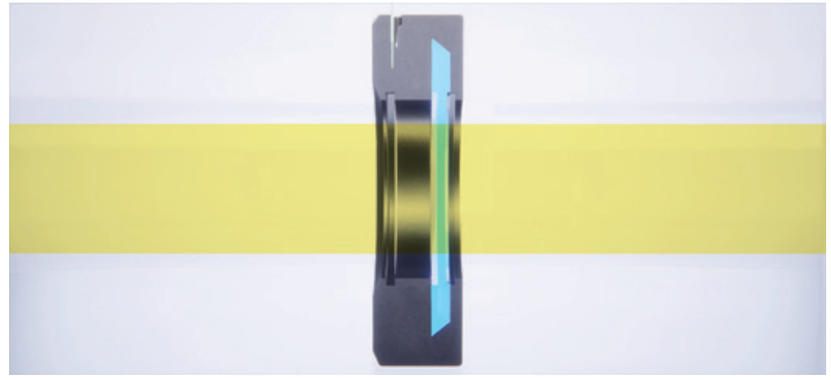
As a result, Optotune's focus tunable lenses have become a key component for highly dynamic vision applications in industrial, medical, and consumer industries.

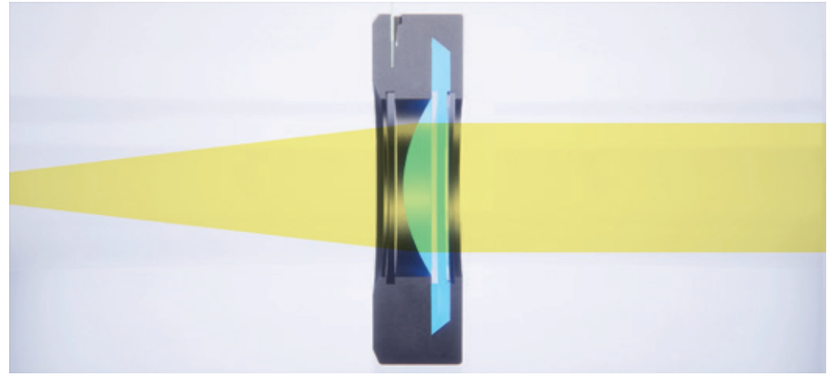
Working principle

The core element of Optotune's focus tunable lenses consists of a container, which is filled with an optical liquid and sealed off with a thin, elastic polymer membrane. A voice-coil actuator pushes liquid into the center of the polymer membrane and deflects it. As a result, the radius of the lens can assume different configurations (from concave to flat to convex) and thus change the optical power of the lens itself. The actuator is usually current controlled, and in some cases built-in temperature sensing, position sensing or optical feedback are used to achieve high repeatability.









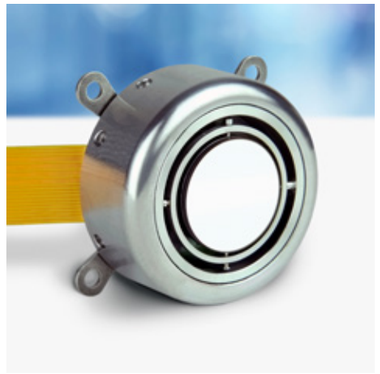
Fast steering mirrors overview

Fast steering mirrors

Optotune's dual-axis fast steering mirror offers the benefit of large deflections and large mirror size in a compact package, thus enabling various imaging applications and easier integration.

Key features:

- 2D beam deflection with a single optical element
- Large clear apertures and beam angles
- Compact & lightweight
- Black housing available



MR-15-30-DVIS

MR-15-30-BK-DVIS with black housing

Product	Mirror size (mm)	Outer diameter (mm)	Mirror coating	Max mechanical tilt (° half angle)	Frequency (Hz)	Wavelength range (nm)
MR-15-30-G 25x25D	15	30	Gold	25°	20	1000 - 20000
MR-15-30-PS 25x25D	15	30	Protected silver	25°	20	400 - 2000
MR-15-30-DVIS 25x25D	15	30	Dielectric VIS	25°	20	400 - 700

All MR-15-30 versions are also available as MR-15-30-BK with black housing to reduce straylight.

For detailed information about Optotune's fast steering mirrors, their applications, FOV expansion and AOI selection (a unique combination setup of a fast steering mirror, liquid lens, and controller), please visit https://www.optotune.com/fast-steering-mirrors

Mirror controllers overview

Controllers

Mirror controller MR-E-3

The MR-E-3 controller can be used with Optotune Cockpit software to drive an MR-series fast steering mirror. The controller is available both in an industrial version with housings, ideal for testing and proof of concept, and an OEM version, suitable for integration with system electronics.

Communication interfaces:

- USB, UART
- SPI (I2C available as customization)
- Analog input (± 5 V)

Software SDKs for Python and C# are available.
The controller is RoHS, REACH and CE certified.

MR-E-3 base unit controller box

MR-E-3 development kit

The MR-E-3 development kit consists of a mirror head unit, controller, power cables, and adapters. The kit is an attractive option for proof of concept and project development work.

MR-E-3 development kit

Standard products	Mirror type included	Components included
MR-E-3 base unit	N/A	MR-E-3 base unit controller box, power supply, USB cable
MR-E-3 mirror head gold	MR-15-30-G-25x25D	Mirror head, cable, protection cap, heatsink
MR-E-3 mirror head silver	MR-15-30-PS-25x25D	Mirror head, cable, protection cap, heatsink
MR-E-3 mirror head DVIS	MR-15-30-DVIS-25x25D	Mirror head, cable, protection cap, heatsink

For detailed information about Optotune's MR-E-3 controller and development kit, as well as OEM solutions, please visit https://www.optotune.com/mirror-controller-mre3

Applications

Large field of view imaging

The challenge:

Machine Vision systems have a fundamental trade-off between FOV and Resolution. Detecting small features in a large field of view is a major challenge in Machine Vision.

Optotune's solution:

Optotune's compact 2D fast steering mirror with a large aperture and tuning range allows to image different Areas of Interest (AOI) in a large Field of View (FOV) with high resolution.

The system can be seamlessly combined with a liquid lens to also provide an unlimited Depth of Field (DOF).

2D fast steering mirror:

- Large field of view
- Compact
- Large Aperture
- Long lifetime

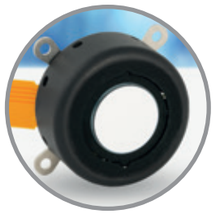
Applications with similar challenges:

- Surveillance
- Traffic sign recognition
- Driver Attention monitoring
- Barcode reading
- Inspection
- Metrology

Mirror and lens combined for FOV expansion and AOI selection

Products:

MR-15-30



MR-15-30-BK

MR-E-3 dev kit

Liquid lenses

Services

Application evaluation, sales, and support

Optotune, with its core competencies and years of experience in challenging applications, is able to assist its customers at the early stages of their product development through feasibility studies and custom designs. Furthermore, our comprehensive approach ensures support not only in the design and production phase, but also during the entire product life cycle.

Feasibility studies:

Optotune supports you to evaluate the feasibility of your application and solve it through your setup with Optotune's products. Our application engineers are available to guide your team through the initial challenges and obtain the best possible results within the shortest time-frame.

Product customization:

Our application and engineering teams support you in drafting the specifications to design the best product for your challenges; throughout the mechanical and optical design simulation our team guides you step-by-step to enhance your current optical setup.

After-sales support:

Optotune provides its customers with an ongoing product support throughout the life cycle of the application. Our team of engineers can assist you and support you at every step of your product development.

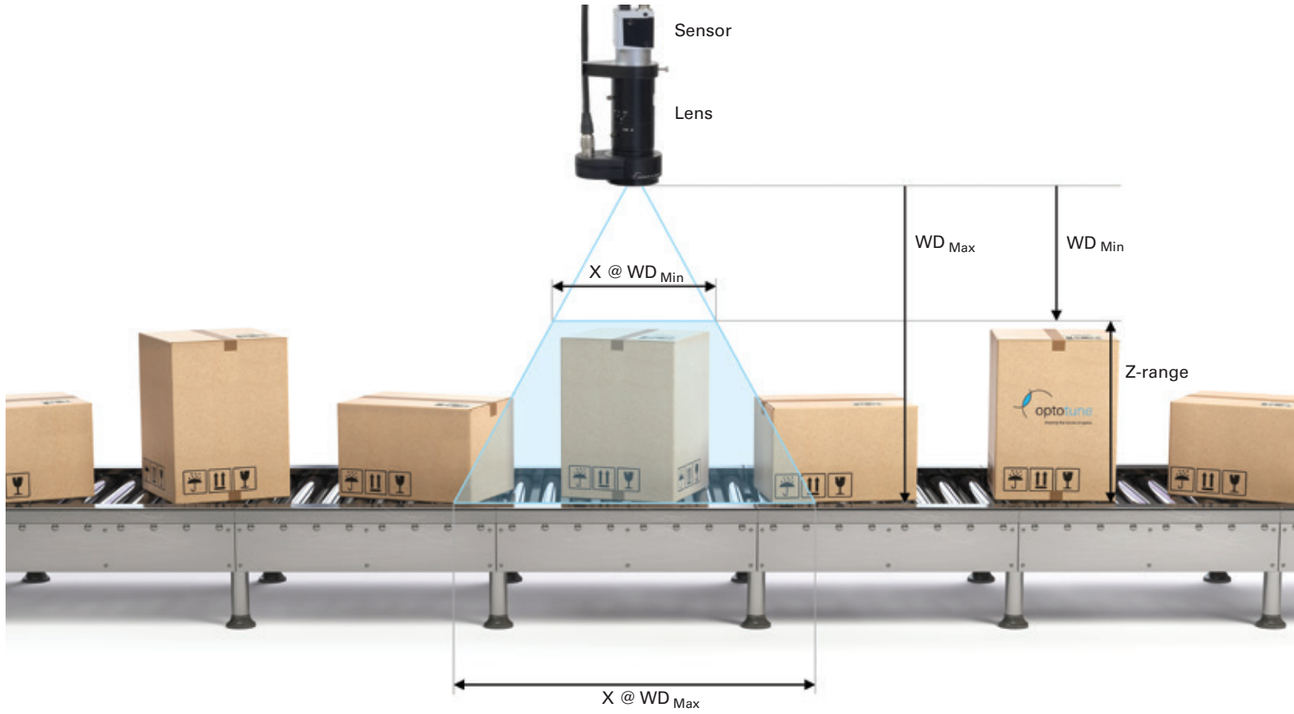
Contact us

Application evaluation, sales, and support

How can we support you? Tell us more about your application.

Key information

- Field of view in X & Y
- Working distance range to focus over (Z-range)
- Desired sensor size & resolution
- Constraints in minimum or maximum WD
- F# (if relevant)



sales@optotune.com

www.optotune.com

+41 58 856 3000

Optotune Switzerland AG
Bernstrasse 388
CH-8953 Dietikon
Switzerland

ONE MILLION LENSES IN ONE

OPTOTUNE EL-16-40 LIQUID LENS

THE SWISS SHAPE SHIFTER - FROM CONCAVE TO CONVEX IN JUST A FEW MILLISECONDS

www.optotune.com