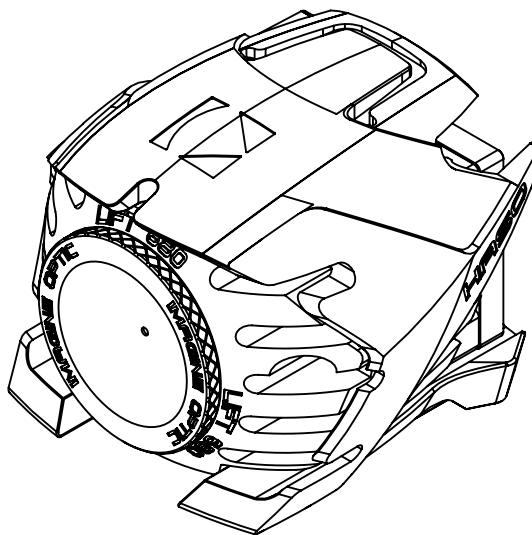


WAVEFRONT SENSORS



A 25-YEAR INNOVATION RUN IN WAVEFRONT SENSING METROLOGY

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Tech. insights

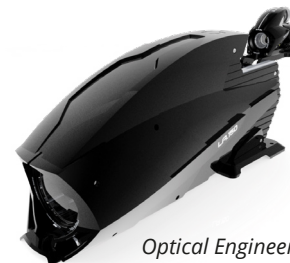
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Imagine Optic 1st generation of -linear!- Shack-Hartmann wavefront sensors was designed and manufactured in Orsay 25 years ago.

Coupling with **deformable mirrors** and constant updates were developed since the early 2000s, leading to the current 4th generation of **HASO**, covering an ever-broader range of applications for optical metrology and adaptive optics.

In 2020 the **LIFT** series added ultra-high resolution, bringing wavefront sensing on par with Fizeau interferometers for most applications.

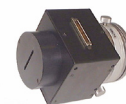
Today, the **Optical Engineer Companion** connects Imagine Optic wavefront sensors and illumination modules, offering over 800 possible metrology setups.



*Optical Engineer
Companion*



LIFT



H-LINE

IMAGINE OPTIC'S **UNIQUE PROPOSITION** IN THE WORLD



Imagine Optic implementation of the **LIFT** phase reconstruction provides a unique resolution increase of x16 to detect the smallest phase changes



Compatible with the **Optical Engineer Companion®** modular system means sensors and optical modules easily combine together to ensure any optical configuration needed



The patented **SpotTracker™** technology provides absolute wavefront and tilt information, eliminating alignment requirements for faster and easier implementation



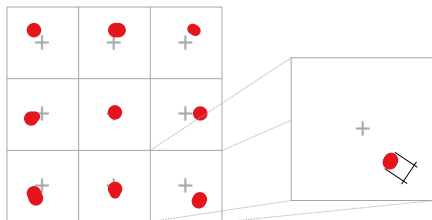
Patented technology for simultaneous and **independent measurements of phase and intensity** prevents artifacts to compromise measurements



POP™, patented procedure for the characterization of (thin) plane parallel optics avoids the need for sample preparation or expensive accessories



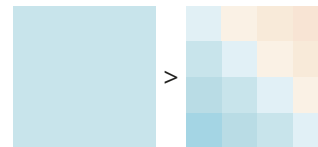
The LIFT principle:



Linearized Focal Plane Technique (LIFT) was developed in the early 2010s and presented in a seminal paper by S. Meimon et al.

The principle is to **analyze the centroid intensity distribution** created by each microlens and use phase retrieval techniques to **reconstruct complex wavefronts at the scale of each microlens**.

Imagine Optic implementation of the LIFT results in a **16-fold increase in spatial resolution** bringing ultra-high resolution to wavefront sensors.





HASO LIFT 272 | The polymath

Best for:

- + Ultra-High Resolution on a budget



HASO LIFT 680 | The Best-in-Class

Best for:

- + Ultra-High Resolution testing
- + Large optics, freeform & metasurface testing, polishing control
- + Use cases requiring large pupil (14x10mm) w/o adapting the beam diameter



HASO SWIR LIFT 160 | The Prodigy

Best for:

- + SWIR metrology (1050-1700nm)
- + High Resolution testing of IR optics and coatings

REACHING INTERFEROMETRY STANDARD IN RESOLUTION

Shack-Hartmann is a very robust and precise technology with a long track record in optical metrology. Yet, its limitations in resolution when compared to interferometry were a clear obstacle to its applications in large and flat optics manufacturing.

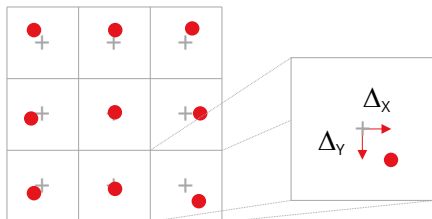
The LIFT technology is a game-changer. LIFT wavefront sensing is now poised to disrupt optical metrology by bringing together the best of two worlds:

- + simplicity, robustness and precision from its Shack-Hartmann core
- + single-frame, ultra high-resolution analysis from the LIFT algorithm.

HAS04 SERIES



Shack-Hartmann principle:



Shack-Hartmann wavefront sensors use a microlens array and a camera to **measure the wavefront local slopes** and compute the aberrations of the beam.

Their reliability makes Shack-Hartmann the **most trusted reference in wavefront sensing** applications



HAS04 BROADBAND | The Workhorse

Best for:

- + Labs and teams with strong expectations for versatility
- + Use cases over a broad spectrum
- + Metrology, microscopy, laser diagnosis



HAS04 FIRST | The Chameleon

Best for:

- + Single wavelength use cases
- + Adaptive Optics applications for microscopy or Ultra-High Intensity Laser
- + OEM applications



HAS04 FAST | The kHz

Best for:

- + Adaptive optics for atmospheric turbulence correction and Free Space Optics
- + Laser beam optimization



HASO4 126 BROADBAND | The Hulk

Best for:

- + Freeform optics & metasurface, parabolic mirror characterization
- + Applications involving high spatial frequency aberrations



HASO4 126 VIS | The big guy

Best for:

- + Freeform optics & metasurface, parabolic mirror characterization
- + Applications involving high spatial frequency aberrations



HASO SWIR | The InGaAs

Best for:

- + Telecommunications, LIDAR
- + Adaptive optics for Free Space Optics
- + IR & SWIR lasers alignment and characterization

KEY ADVANTAGES OF SHACK-HARTMANN WAVEFRONT SENSING

#1 LIVE

Dynamic measurement of all the parameters

#2 ROBUSTNESS

Insensitive to vibrations and atmospheric turbulences

#3 ACCURACY

Standard accuracy of $\lambda/100$ RMS

#4 ACHROMATISM

Achromaticity on the whole spectral range of the sensor

#5 EASE OF USE

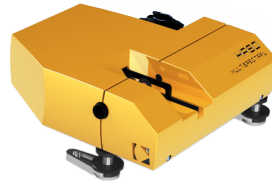
Thanks to factory calibration and powerful WAVESUITE algorithms



HASO HXR | The X

Best for:

- + X Rays single shot wavefront sensing in the 5-25 keV energy range
- + Source characterization
- + Beamline, KB, toroidal mirrors, elliptical mirrors alignment



HASO MULTISPECTRAL | The polychromatic

Best for:

- + Spatio-temporal characterization
- + Compressor alignment
- + Measurement of spatial chirp, chromatic curvature
- + Characterization of phase spectral effects on dielectric coatings



HASO EUV | The Hartmann

Best for:

- + Synchrotron, EUV-FEL and laser-driven secondary source alignment and characterization
- + Micro- and nano-focusing
- + Dense plasma diagnostics

HASO **EDGE** SERIES



HASO VERY LOW FLUX

- + 10nm RMS repeatability @ 10000 ph/s
- + 26 x 18 phase points
- + visible range



HASO SWIR FAST

- + 940 - 1700 nm
- + 1.9 kHz
- + 3.26 mm x 3.26 mm



HASO VACUUM

- + 10^{-6} mbar with no outgassing
- + 40 x 32 phase points
- + 650 - 950 nm

Imagine Optic's trademark for over 25 years has been to develop and deliver made-to-measure solutions to scientific and industrial conundrums. Across dozens of wavefront sensors that were born to **meet specific needs**, we have carefully selected the EDGE series. They are essentially clones that can be quickly produced and delivered to meet specific requirements.

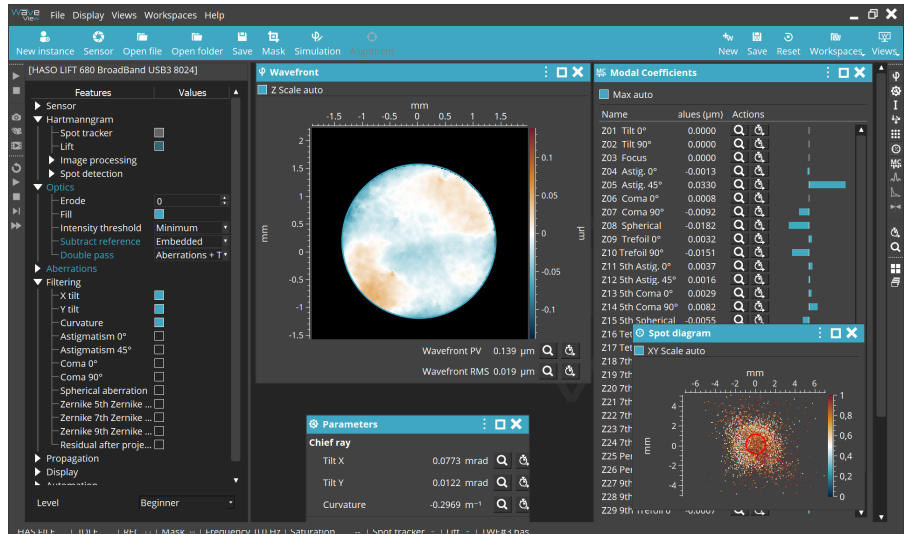
Other EDGE wavefront sensors are available : contact us to discuss our **extensive portfolio of custom wavefront sensors** and application-specific implementations.

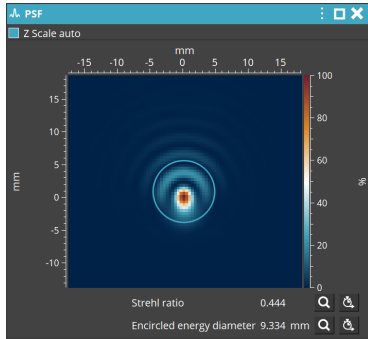
WAVEVIEW

WAVEVIEW™ is the most advanced wavefront measurement and analysis software.

Its interface offers an **easy and optimized workflow**: configure the acquisition, analyze the results in live and export the results for an absolute traceability.

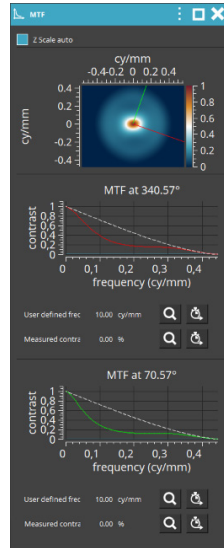
It offers more than 150 features and tools covering a wide range of highly demanding applications.





Extensions are available to complete the features offered by WaveView.

Get the **PSF** (top) or calculate the 360 **MTF** (right) in only one shot!



WAVEKIT

WAVEKIT is a versatile and **comprehensive SDK** allowing to integrate Imagine Optic wavefront sensors in complex applications: multi-modal platforms, automated benches, industrial control, etc.

Available for C/C++, LabVIEW™ and python™.



SERVICES

All our hardware equipment comes with complementary services:

- + **Installation** assistance by our technicians and engineers
- + **Training** on both software and hardware, on site or remote
- + **Support** through our Zendesk-powered interface featuring FAQs, troubleshooting and other useful resources as well as a customer login and assistance system with a > 90 % satisfaction rating

Imagine Optic also provides on-demand services :

- + **Recalibration** of HASO wavefront sensors
- + **Equipment rental**
- + **Characterization** of optical components and systems
- + **Custom** optical metrology and adaptive optics benches

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