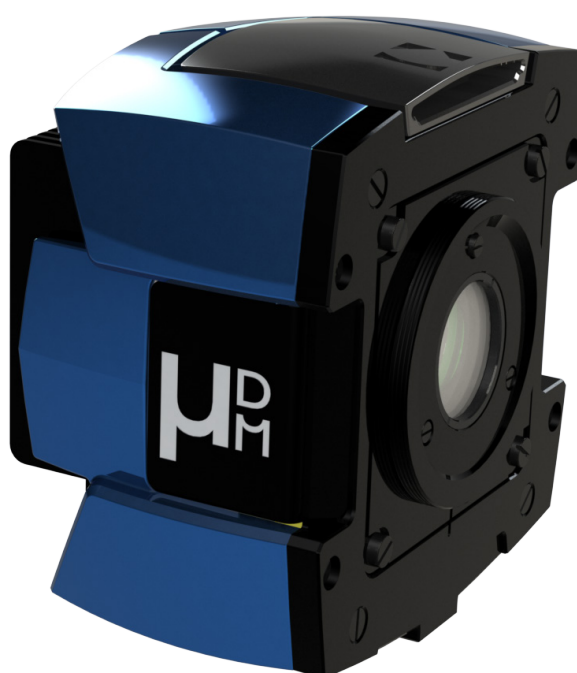




# MU-DM

Deformable mirror  
**For microscopy & ophthalmology**

High dynamic range linearity & stability  
Embedded electronics  
High actuator density



Boost your imaging performance :  
Adaptive Optics made easy and efficient.

## APPLICATIONS

### With Adaptive Optics (AO) for microscopy :

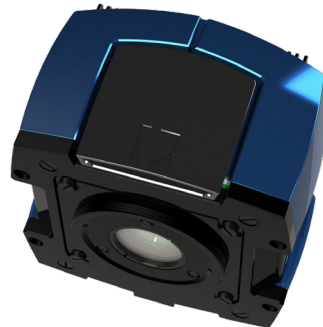
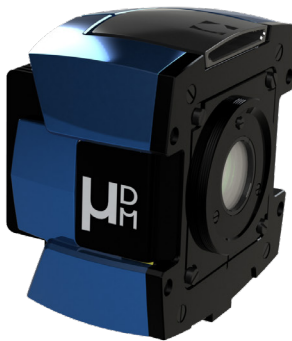
- + Image deeper in your sample with correction capabilities that restore diffraction-limited Point Spread Function (PSF) in non-linear (like multiphoton) or light-sheet microscopy
- + Navigate in 3D in Single Molecule Localization Microscopy (SMLM) by shaping the PSF to your needs, using astigmatism or tetrapod

### With AO for retinal imaging :

- + Explore retinal cells at high-resolution by correcting ocular aberrations in Optical Coherence Tomography (OCT), Scanning Laser Ophthalmoscopes (SLO) or flood illumination modalities

## FEATURES

- + **Fast closed-loop convergence and accurate sensorless correction** with perfect linearity and absence of hysteresis
- + **Preserved photon budget** with achromatic, highly reflective and continuous membrane
- + **Long-term stability** with temporal drift automatic compensation
- + **Large dynamic range** with 50% of actuators stroke still available while generating 40 microns PtV of focus
- + **Fine timing control** with trigger-in and trigger-out features
- + **Easy integration** with electronics embedded in a single-piece design and connection via a USB3 cable
- + **Correction up to 10th Zernike order** thanks to optimized actuator layout



# SPECIFICATIONS

## OPTICAL SPECS

Surface quality  
Coating  
Linearity  
Hysteresis

7 nm RMS (Optional : down to 4 nm RMS)  
Protected silver  
> 99.5%  
< 0.1%

## OPERATING SPECS

Number of actuators  
Maximum generated wavefront (PV)  
- 1 actuator  
- 7 actuators  
Effective diameter  
Spatial frequency correction  
Rise time  
Max frequency  
Temporal stability

91  
> 10  $\mu\text{m}$   
> 50  $\mu\text{m}$   
15 mm  
Zernike orders up to 10  
2.4 ms  
Typically 300 Hz  
< 15 nm RMS over 12h

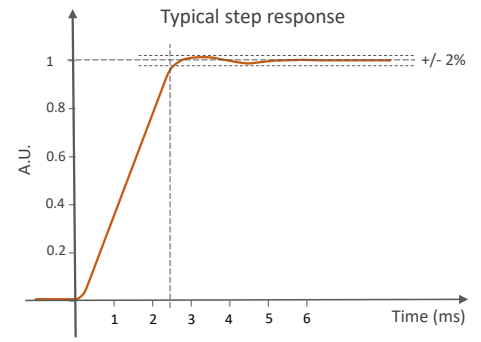
## MISC

Dimension / Weight  
Working temperature  
Interface / Power consumption

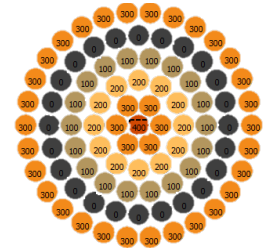
93.8 x 98.3 x 67.2 mm<sup>3</sup> / 185 g  
19-25°C  
USB 3.0 / 30 W

## OPERATING SYSTEM

Windows 10

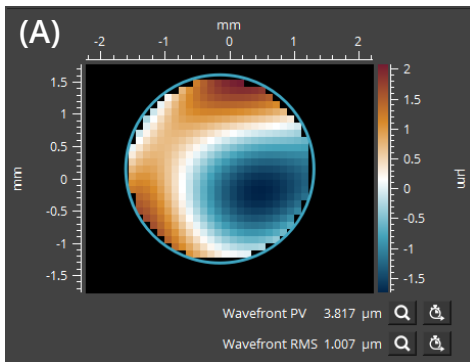


Optimized temporal control achieves a settling time of 2.4 ms with minimal over-shoot (< ±2%)

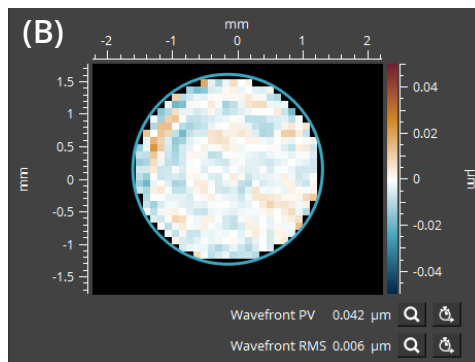


Centro-symmetrical layout is ideal to generate Zernike polynomials in closed-loop and open-loop

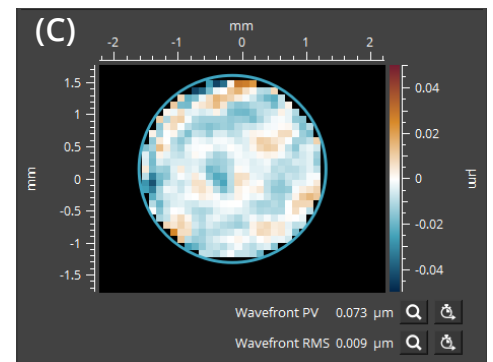
High linearity leads to a remarkable behavior as you can see below :  
(A) Input wavefront (B) Results in closed-loop (C) Results in open-loop



Target wavefront is 1.007  $\mu\text{m}$  RMS  
(combination of Zernike polynomials up to the 4th order)

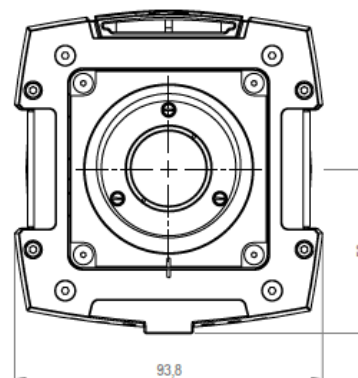
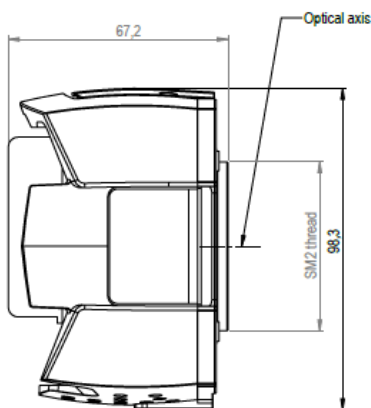


Wavefront error in closed-loop  
WFE = 6 nm RMS



Wavefront error in open-loop  
WFE = 9 nm RMS

# DIMENSIONS (mm)

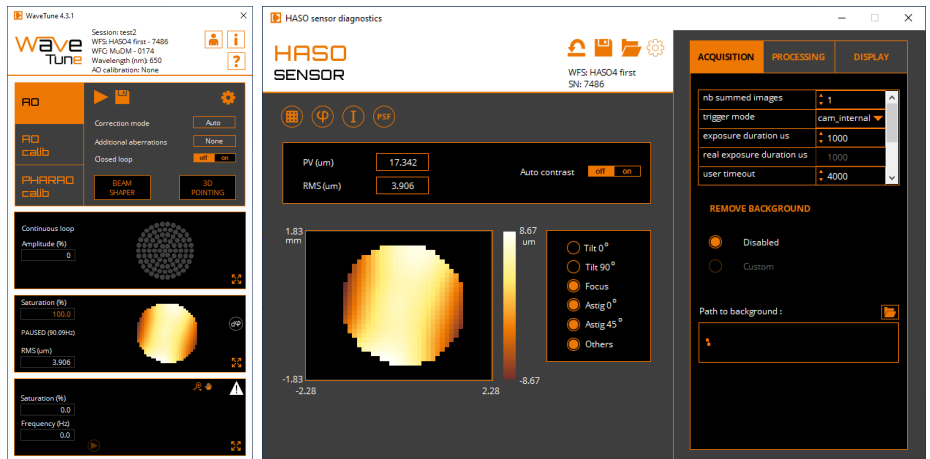


## SOFTWARE

### WAVETUNE

WAVETUNE is a unique software that seamlessly combines wavefront measurement and correction features with extensive instrument diagnostics.

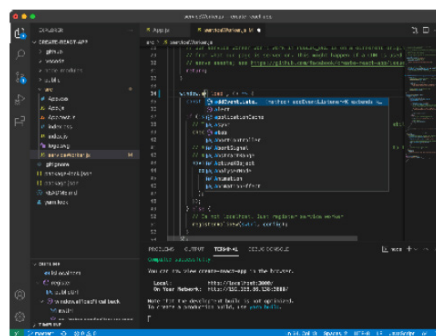
This software contains all the necessary tools to calibrate the Deformable Mirror (DM). It can also operate the DM in closed-loop with HASO wavefront sensor, as well as in open-loop and perform beam shaping.



### WAVEKIT BIO

WAVEKIT BIO is a Software Development Kit (SDK), available in C++ and Python, specifically designed for microscopy applications.

In particular, it contains all the necessary functions to implement sensorless AO, using image-based iterative algorithms (e.g. 3N).



## MOUNTING & ACCESSORIES

Several mounting options are available, including adaptors for the most common mechanical stages, to simplify integration of  $\mu$ DM into an optical setup.



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