Reflection configured Digital Holographic Microscope (DHM®), a non-scanning and non-contact method for static and dynamic 3D topography as well as vibration characterization.

Please visit www.lynceetec.com and contact us for more information and examples of applications.

Unrivaled Speed

DHM® measures the 3D topography map of a surface with a single acquisition, without any scanning mechanism required. It provides unbeatably fast acquisition, at camera rate of up to 100’000 fps, enabling:

- Study of the 3D dynamic behavior of deformable samples
- Fast screen and analysis of large surfaces
- Routine inspections with high productivity
- Capture of 3D topographies on the production line, without stopping the sample

MEMS analysis, up to 25 MHz

The optional stroboscopic unit synchronizes the DHM® measurements with the excitation signal of a MEMS device. The analysis of this unique set of data provides:

- Time-sequence of 3D topographies
- Frequency resonances and responses
- Vibration amplitude with resolution of 5 pm for out-of-plane
- 1 nm for in-plane displacements
- Characterization of complex motions and sample geometries, including in presence of holes

Measure in controlled environmental conditions

The unique optical configuration of DHM® enables the user to measure with optimal optical quality:

- Through glass and immersion liquids
- Inside environmental and vacuum chambers, under controlled temperature, humidity, pressure or gas composition

Measure topography of transparent patterns

The optional DHM® Reflectometry analysis software enables the measurement of:

- Topography of transparent structures
- Thicknesses and refractive index values of structured multi-layers with thicknesses ranging from 10 nanometers to tens of microns
- Topography of soft materials and liquids

DHM®

The Digital Holographic Microscopy (DHM®) is a patented technology. It records, with a digital camera, holograms produced by the interference between the beam reflected by the sample, and a reference beam generated inside of the microscope. The holograms are processed numerically to reconstruct a 3D optical map of the specimen.

The vertical calibration of DHM® is intrinsically defined by the laser wavelength. It provides high accuracy and reproducible data and measures with interferometric resolution, i.e. a subnanometric vertical resolution, and a lateral resolution limited by the choice of microscope objective.

Thanks to advanced numerical processing of the recorded hologram, sharp focus can be performed simultaneously or after measurement, as a post-processing without manually adjusting the height of the sample.

DHM® - R series

Time sequence of 3D topographies, limited by camera rate: evaporation of a liquid drop

Time

DHM® measuring through a glass window
Three configurations of Reflection DHM® are available, differentiated by the number of wavelengths.

- **R1000 models** are configured with a single wavelength and are the ideal tool for measuring smooth surfaces and vibrations.
- **R2100 models** are configured for measuring simultaneously at two wavelengths for achieving measurement of complex or discontinuous structures.
- **R2200 models** are R2100 with a third source to extend measurement capability, in particular for measuring transparent patterns.

### Technical specifications

<table>
<thead>
<tr>
<th>System</th>
<th>R1000</th>
<th>R2100</th>
<th>R2200</th>
</tr>
</thead>
<tbody>
<tr>
<td>D HM models</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Number of laser sources</td>
<td>675 nm</td>
<td>675 nm, 794 nm</td>
<td>666 nm, 794 nm, 675 nm</td>
</tr>
<tr>
<td>Operating wavelength (± 1.0 nm)</td>
<td>Laser wavelength stability</td>
<td>0.01 nm/°C at 675 nm</td>
<td></td>
</tr>
<tr>
<td>Sample stage</td>
<td>Manual or motorized XYZ stages up to 300 mm x 300 mm x 38 mm travel range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objectives</td>
<td>Magnification 1.25x to 100x, standard, high NA, long working distance, water/oil immersion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective turret</td>
<td>6 positions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>Workstation with latest multicore Intel® processor, high performance graphic card</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>Optimized and configured for DHM with screen min 21inch and mouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Proprietary Koala software based on C++ and .NET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional optional software modules available for advanced analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data compatibility</td>
<td>Measurement data recorded in bin format, exportable in .tif format, recorded and reconstructed images exportable in .txt format or .txt array</td>
<td></td>
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</tr>
</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Measurement mode</th>
<th>Single wavelength at 675 nm</th>
<th>Short synthetic wavelength at 4.4 μm</th>
<th>Long synthetic wavelength at 50 μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>D HM models</td>
<td>R1000, R2100, R2200</td>
<td>R2100, R2200</td>
<td>R2200</td>
</tr>
<tr>
<td>Accuracy [nm]</td>
<td>0.15</td>
<td>0.15 / 3.0 *</td>
<td>20</td>
</tr>
<tr>
<td>Vertical resolution [nm]</td>
<td>0.30</td>
<td>0.30 / 6.0 *</td>
<td>40</td>
</tr>
<tr>
<td>Repeatability [nm]</td>
<td>0.01</td>
<td>0.01 / 0.1 *</td>
<td>0.5</td>
</tr>
<tr>
<td>Vertical measuring range</td>
<td>up to 200 μm</td>
<td>up to 200 μm</td>
<td>up to 200 μm</td>
</tr>
<tr>
<td>Max. height of steps with sharp edges</td>
<td>up to 333 nm²</td>
<td>up to 2.1 μm²</td>
<td>up to 24 μm²</td>
</tr>
<tr>
<td>Surface type</td>
<td>Smooth surfaces</td>
<td>Complex or discontinuous structures</td>
<td>Complex or discontinuous structures</td>
</tr>
<tr>
<td>Vertical calibration</td>
<td>Determined by interferometric optical filter, ±0.1 nm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition time</td>
<td>Standard: 500 μs (optional 10 μs)</td>
<td></td>
<td></td>
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<tr>
<td>Acquisition rate</td>
<td>Standard: 190 fps (1024 x 1024 pixels). (optional up to 100’000 fps).</td>
<td></td>
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<tr>
<td>Reconstruction rate</td>
<td>Up to 25 fps 1024 x 1024 pixels hologram (data analysis dependent). (optional up to 60 fps)</td>
<td></td>
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<tr>
<td>Lateral resolution</td>
<td>Objective dependent, down to 300 nm **</td>
<td></td>
<td></td>
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<tr>
<td>Field of view</td>
<td>Objective dependent, from 66 μm x 66 μm up to 5 mm x 5 mm **</td>
<td></td>
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<tr>
<td>Working distance</td>
<td>Objective dependent, from 0.3 to 18 mm **</td>
<td></td>
<td></td>
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<tr>
<td>Digital focusing range</td>
<td>Up to 50x depth of field (objective dependent)</td>
<td></td>
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<tr>
<td>Min. sample reflectivity</td>
<td>Less than 1%</td>
<td></td>
<td></td>
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<tr>
<td>Sample illumination</td>
<td>Down to 1 μW/cm²</td>
<td></td>
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<tr>
<td>Stroboscopic unit</td>
<td>Compatibility with single and short synthetic wavelength</td>
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</tbody>
</table>

### Power requirements

- Input voltage: 85-260 VAC – 50/60 Hz
- Power requirements: max. 250 W

### Dimensions & weight

- Dimensions (L x W x H): 600 x 600 x 800 mm
- Weight: 48kg

1. As demonstrated by taking the temporal standard deviation on 1 pixel over 30 measurements
2. Defined as twice the accuracy
3. As demonstrated by taking the one sigma Rq value of 30 repeatability measurements without sample
4. Depends on the laser source(s) and operating wavelength(s)/
   * With / Without single wavelength mapping
   ** Objectives specifications on www.lynceetec.com/microscope-objectives

DHM® systems are compatible with a large choice of options:
- Objectives with extra-LWD, cover-glass correction, for immersion, etc.
- Motorized stage for automation and stitching
- Remote TCP/IP module for automation and remote control of DHM
- Stroboscopic unit for MEMS analysis
- Environmental chamber for measuring under controlled conditions