lyncée tec DHM®

Digital Holographic Microscopy

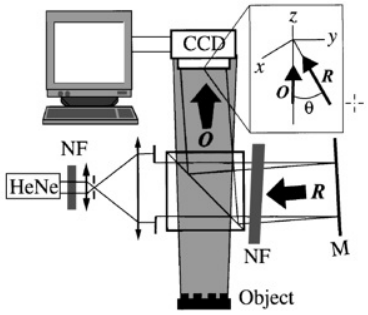
Metrology Applications using Digital Holography Microscopy (DHM®)

reported in the Journal of Physics Photonics

From Pioneer work in 1999 ...

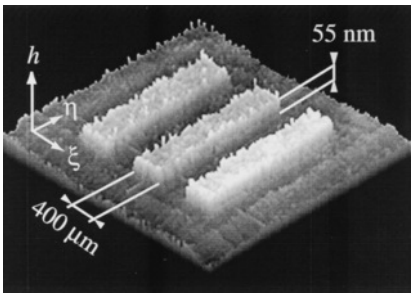
Optics Letters (Vol. 24, No. 5) and Applied Optics (Vol. 38, No. 34)

The first simultaneous reconstructions of both optical topography and intensity image out of a single hologram acquired in off-axis configuration were demonstrated
by **Lyncée CTO Etienne Cuche** and his co-workers.



The principle of this new full field imaging method is demonstrated for

- reflection microscopy
- transmission microscopy
- lens-less set ups



Many commercial applications are foreseen for both bio-imaging and material sciences applications.

DHM® specifications in 1999

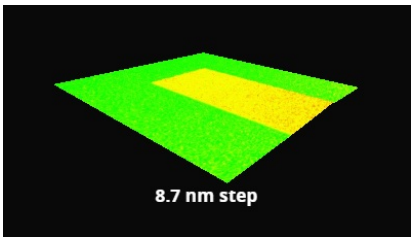
- Camera 512x512 pixels, 8 bits
- Reconstruction rate ≈ 1 Hz
- Vertical resolution ≈ 10 nm

... to revolutionary and matured applications in 2021

Journal of Physics: Photonics

The Journal of Physics Photonics reports cutting edge commercial metrology applications exploiting the DHM unique specificities:

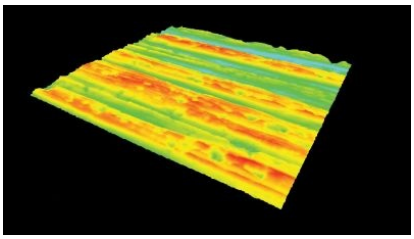
- Camera frame data acquisition rate: **up to 100 kHz @ 1 MPixels**
- Real time data display: **> 60 fps**
- Interferometric: **subnanometer vertical resolution**
- In-situ measurements: **in air, liquids, vacuum, ...**



Metrology certifications

As a **non-scanning technology**, DHM refers purely to laser wavelengths for height measurements.
The measured height values do not depend on any scanning calibration, precise positioning, absence of long term drift, repeatability of interferometric piezo-controller, or on any motorized displacement.

DHM laser metrology

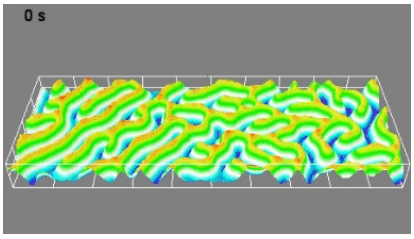


3D optical profilometry

Topography measurements with interferometric resolution in the folllowing domains:

- Semiconductor
- Micro-optics
- Micro-nano systems
- Smart surfaces and polymers
- Microfluidics
- Watch industry

3D DHM profilometry

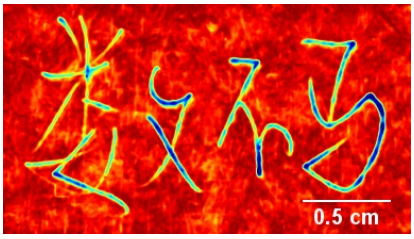


4D (Time-resolved 3D)

Acquisition at camera rate @ 194 fps standard and optionaly >100 kfps enables characterization of samples real time response due to:

- Thermodynamic changes
  thermal expansion, melting, evaporation ...
- Chemical action
  electro deposition, corrosion, etching, dissolution ...
- Mechanical forces
  material release, pressure, tribology indentation ...
- Light irradiance
- Electromagnetic forces
- ...

4D DHM solutions



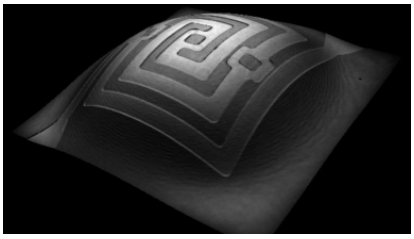
Large surfaces measurements

Automated samples stages in conjunction with fast acquisiton rates and short acquisition time (i.e short camera shutter duration) enables:

- Stitching over large areas
- Full wafer inspection
- Fast defects screening

In the signature recognition application shown here, the Institute of Forensic Sciences in Shanghai, China, measure surface of 20 mm x 30 mm, i.e. **3000 single images** in less than 60 seconds

Learn more



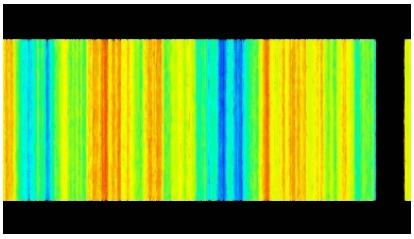
Environmental & in-situ

Measurements unsensitive to environmental disturbances such as:

- Vibrations
- High temperature turbulences
- Cryogenic environement
- Sample floating on liquid interface
- ...

Measurement of samples in air, gas, vacuum and liquid.

Applications



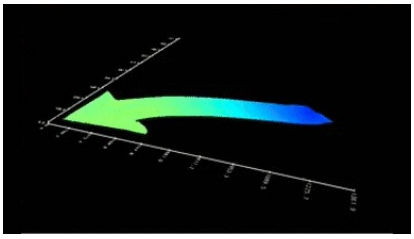
On-flight characterization

Characterization of samples in motion, without stopping for acquisition.

Applications exemples:

- Quality control on convey trays
- Continuous roughness control
- Feedback to manufacturing tools
- Moving micro-objects and robots
- ...

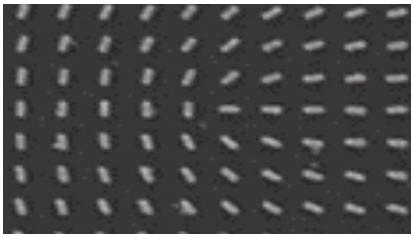
Learn more



MEMS: time and frequency

From DC to 25 MHz characaterization of:

- Actuators & micro-motors
- Ultrasonic transducers (MUT)
- Accelerometers & Gyroscopes
- MOEMS and variable lenses
- Micromiorrors & DMDs
- Microphones & resonators
- Liquid Crystal on Silicon (LCOS)
- Surface Acoustic Waves (SAW)
- ...



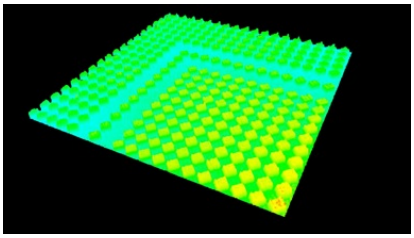
Polarization

Birefringence is a central and key property for characterizing

- Liquid crystal displays,
- Optical telecom devices,
- MOEMS,
- Photonics crystals
- Forces and stress analysis
- Metasurfaces
- ...

Polarization by DHM

Holographic MEMS analyzer

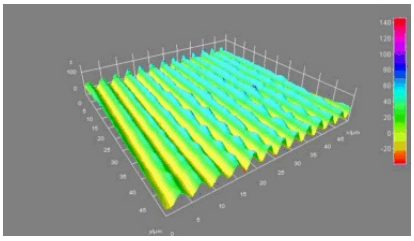


Thin transparent structures

Measure topography, thicknesses and refractive indexes of transparent structures

- Measurement of surface structures from 10 nanometers to several microns
- Measurement of refractive indices
- Characterization of deposited or etched structures composed of up to 3 layers

DHM reflectometry



Measure as you manufacture

Measuring in-situ and in-real time a substrate during its manufacturing provides immediate feedback for optimizing micro and nano processes:

- Femto laser engraving
- Laser polishing
- Additive manufacturing
- Etching
- Lithography
- ...

Improved quality

A reference publication

Metrology applications using Off-axis Digital Holography Microscopy
Journal of Physics: Photonics, DOI: 10.1088/2515-7646/abf743, 2021

The authors

Etienne Cuche, PhD, CTO Lyncée Tec SA

"I remember very well the moment when the first reconstructed phase image appeared on the screen of a computing station. The process was slow and included a 500-meters walk to transfer the painfully digitized hologram on an 8-inch floppy disk, from the laboratory to the computing room. I was very happy with this first result, but far from imagining that today, this process would contribute daily to advanced research and quality control of sensitive components, all over the world.

The Lyncée adventure was decisive in opening up unsuspected fields of application that boosted the rapid and continuous development of the technology. For almost twenty years now, our team has been exploring the slopes of digital holographic microscopy in a pioneering spirit. The more the ascent progresses, the more the potential for innovation expands. This is a great source of satisfaction and motivation."

Tristan Colomb, PhD, R&D Manager

"I met Etienne back in 1998. Excited by his new method to extract phase information from a single hologram, I joined him for my master thesis on the development of numerical optics to compensate for optical aberrations. After a PhD on polarization imaging and numerical lenses, I have developed the 4D tracking and reflectometry applications at Lyncée.
In 2021, my enthusiasm is higher than ever when I see the evolution of DHM® and its

applications"

Yves Emery, PhD, CEO Lyncée Tec SA

"It has been a great technical and human experience to bring DHM® systems from R&D setups to commercial solutions. Motivated by the enthusiasm of many early adopters, co-workers, and academic and industrial partners, we have discovered, demonstrated, and developed DHM® applications one by one. We are proud of our large base of systems installed at renown research and industrial facilities worldwide. They enable to perform measurements previously not possible with other technologies.

Book a DHM live-demo now !

Do you want to discover our product while avoiding unnecessary travels and interactions during the COVID-19 situation?

For any DHM® purchase based on a remote live-demo, Lyncée commits to plant trees through the non-profit organization OneTreePlanted and to provide you with a certificate.

Join our DHM users' forest of already more than 1700 trees!

Contact us to book a live demo!

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