Speaker: Maria Lopera

MSc Applied Physics Physics Engineer

> Advisor: Carlos Trujillo

Associated Professor Universidad EAFIT Ph.D. Physics Lensless holographic microscopy with holographic point sources and linear diattenuation sensitivity



APPLIED OPTICS research group





Lensfree microscopy What is lensfree microscopy



Advantages of polarized sampling Linear diattenuation sensitive DLHM



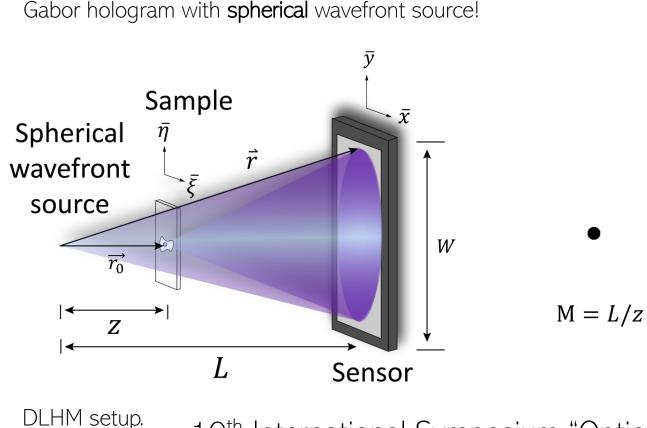
Portable DLHM: enhancing on-field measurements Freeform-based point source (With B-PHOT VUB)

Holographic point source





1 Digital Lensless Holographic Microscopy



Advantages

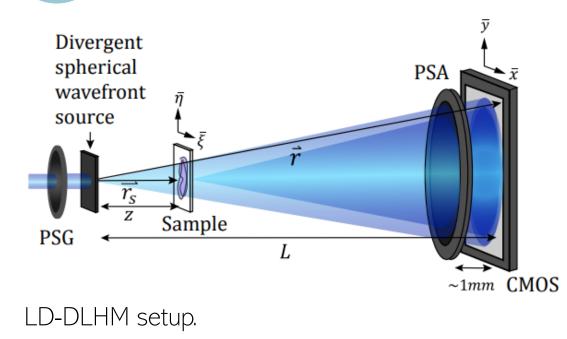
- Simplest microscopy setup
- Low-cost device
- Allow portable implementations
- Could achieve same

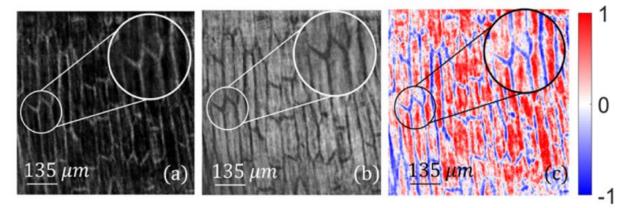
performance as bulky and expensive devices

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2 Linear diattenuation DLHM



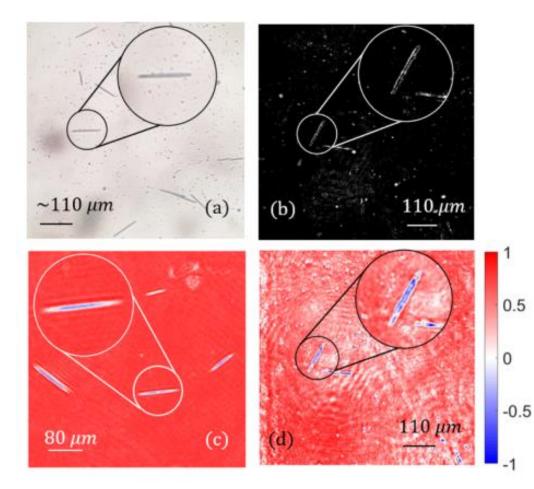


Intensity images and diattenuation response recovered via our LD-DLHM of a sample containing a layer of onion cells. (a) I_0 intensity image, (b) I_{90} intensity image, and (c) diattenuation response of the sample.

Products

- M. J. Lopera and C. Trujillo, "Linear diattenuation imaging of biological samples with digital lensless holographic microscopy," Appl. Opt. 61, B77 (2022).
- M. J. Lopera and C. Trujillo, "Linear diattenuation sensitive lens-free holographic microscope," Digital Holography and 3D Imaging, OPTICA (2022).





Linear diattenuation response of an experimental sample with calcium oxalate crystals. (a) Intensity bright-field image of the sample. (b) Intensity reconstruction obtained via conventional DLHM. (c) Linear diattenuation response of the sample, using a polarimetric bright-field microscope. (d) Linear diattenuation response via the proposed LD-DLHM of the same sample in (b).

3 Speciallized illumination sources

DLHM resolution:

• The limited **temporal or spatial coherence** limits the maximum observable fringe frequency.

Highly spatial coherent spherical source:

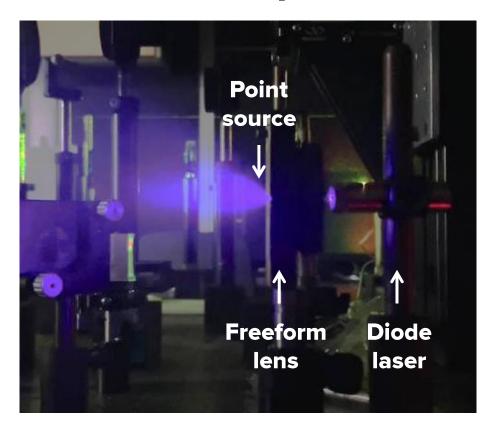
Point source.

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Freeform-based point source



Picture of the FF-DLHM setup

a.2 150 μm Intensity reconstruction of a sample containing epithelial cheek cells (saliva) with (a) the proposed FF-DLHM.

a.

Paper in peer review process in **Optics Express**: "Freeform-based illumination source for digital lensless holographic microscopy."

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a.1

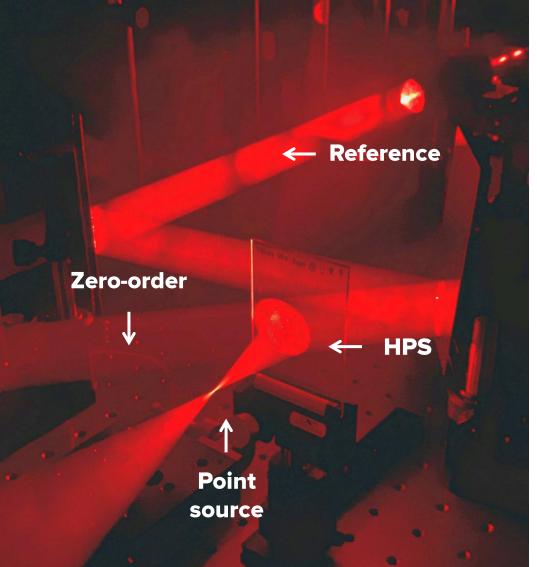






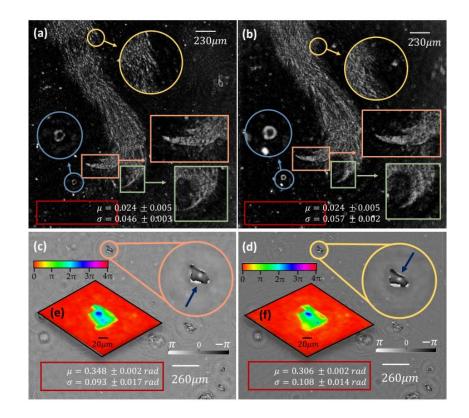
Exchange Master of Science in Photonics Engineering





- M. J. Lopera and C. Trujillo, "Holographic optical element for digital lensless holographic microscopy's illumination," Optics Letters (2022).
- M. J. Lopera and C. Trujillo, "Holographic optical element for digital lensless holographic microscopy 's illumination," in Digital Holography and Three-Dimensional Imaging. Vol. 2, pp. 7–8.

Holographic Point Source (HPS)



Intensity reconstruction of a honeybee leg using (a) our HPS-DLHM proposal and (b) conventional DLHM. Raw (wrapped) phase reconstructions and unwrapped 3D topographic views of cheek epithelial cells. Panels (c) and (e) were obtained with our HPS-DLHM, and (d) and (f) via conventional DLHM.



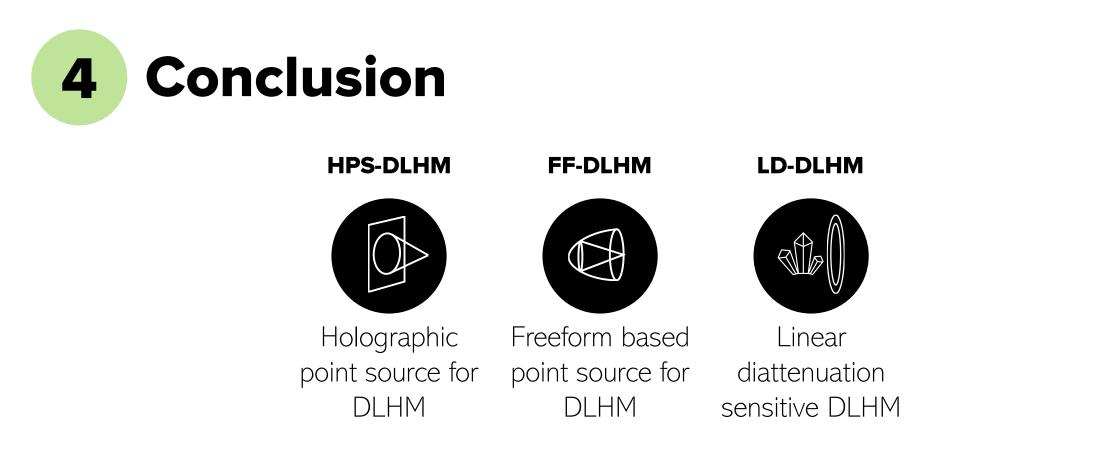
Portable FF-DLHM

- Stable mechanical coupling.
- Compatible with any cellphone.
- Cost-effective prototype.
- Powered with a rechargeable battery.

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Our contribution constitutes a microscope that is portable, stable, easy to align, and easy to use, that enhances the DLHM technique and, in general, the portable devices which can be applied to potentiate the diagnosis of certain diseases.





















Thank you all! Any question?