

DIGITAL HOLOGRAPHY IN MICROSCOPY FOR BIOMEDICAL AND ENVIRONMENTAL STUDIES



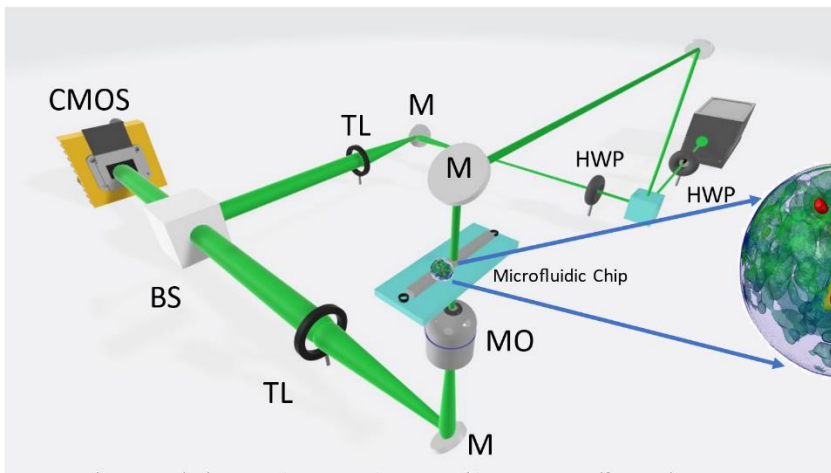
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Curriculum: Ingegneria dei Materiali e delle Strutture

Digital holography (DH) is a non-invasive, label-free, quantitative, and high-resolution imaging technique^{1,2} employable for biomedical³ and environmental^{4,5} purposes, but not only. The digital hologram is an interference pattern which is originated by interference between a reference beam and an object beam. The digital recording of the holograms permits to calculation of the complex wavefront, and then, the amplitude and phase of specimen can be extracted separately. Owing to the use of microscope objective (MO), quantitative microscopic phase-contrast image can be obtained by DH; the lateral resolution can reach at submicron scale. Once the hologram has been recorded, the phase map of the object can be reconstructed by means of numerical procedures; in particular, it is possible to operate a re-focusing procedure by means of the diffraction integral and obtain also morphometrical features from amplitude and phase maps^{6,7}.

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- [3] Pirone, D., **Sirico, D.**, Miccio, L., Bianco, V., Mugnano, M., Giudice, D. del, Pasquinelli, G., Valente, S., Lemma, S., Iommarini, L., Kurelac, I., Memmolo, P. and Ferraro, P., "Lipid droplets 3D full measurement by holographic in-flow tomography," *bioRxiv*, 2021.12.09.471789 (2021).
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- [6] Memmolo, P., Pirone, D., **Sirico, D. G.**, Miccio, L., Bianco, V., Ayoub, A. B., Psaltis, D. and Ferraro, P., "Single-cell phase-contrast tomograms data encoded by 3D Zernike descriptors" (2022).
- [7] Miccio, L., Pirone, D., **Sirico, D.**, Merola, F., Memmolo, P., Bianco, V., Wang, Z., Běhal, J., del Giudice, D., Mugnano, M. and Ferraro, P., "Tomographic phase microscopy at single cell scale without a-priori knowledge of cell orientations: smart strategies for rotation angles recovery," *Unconventional Optical Imaging III*, M. P. Georges, G. Popescu, and N. Verrier, Eds., 68, SPIE (2022).

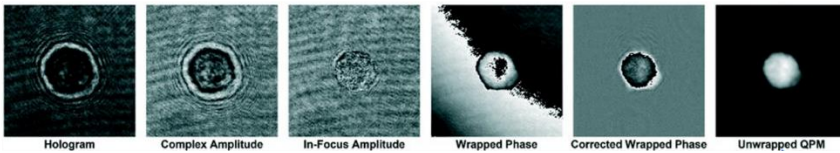
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Quantitative information:

- Refractive Index
- Dry Mass
- Volume
- Area

BS Beam Splitter, TL Tube lens, M Mirror, MO Microscope Objective, HWP Half-wave plate



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