

Phase quantification techniques for to study biological samples

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Abstract

In this talk, we present some advances about the work in the Applied Optics Group (AOG) of the Physics Department of the National University of Colombia in Bogotá.

As an application of off-axis split beam systems to obtain the phase quantification images (*PQI*) in the AOG, the Digital Holographic Microscopy (*DHM*) technique was initially implemented, with which applications have been developed in two directions: initially were carried out palynological studies for the characterization of pollen grains of several species and families, measuring the thicknesses of their exine and nexin layers, and their respective refractive indexes, giving the palynologists new parameters for the taxopalinology. On the other hand, the morphometric and refractive index variations suffered by macrophages were studied when they were infected by the *Leishmania* *Brazilensis* virus at different times of infection.

As an application of off-axis and common path systems, the Diffraction Phase Microscopy (*DPM*) technique is currently being implemented, which has the characteristics of requiring only one record and with the quality of being mechanically very stable, since *DPM* uses a compact Mach-Zehnder interferometer to combine several attributes of the current *PQI* methods. With this technique, the study of human blood is being initiated in which blasts are being identified from the morphometric characterization of the peripheral blood cell population, for the diagnosis of acute lymphocytic leukemia.

On the other hand, as an application of phase shift techniques, we are implementing the technique of the Point Diffraction interferometer (*PDI*), which, with the principle of Gabor's holography, has the main characteristic of using a monapixel liquid crystal display and perform a digital phase shift to the wave that carries the information of the object; with this technique, micrometric objects have been initially described and progress is made towards the study of biological samples.

Recent Publications

- [1] "LCoS display phase self-calibration method based on diffractive lens schemes", H. Zhang, A. Lizana; C. Iemmi, F. Monroy-Ramirez, A. Marquez, I. Moreno, J. Campos; Optics and Lasers in Engineering; 106, 147-154, (2018).
- [2] "Wavefront imaging by using an inline holographic microscopy system based on a double-sideband filter", H. Zhang, F. Monroy-Ramirez, C. Iemmi, N. Bennis, P. Morawiak, W. Piecek, J. Campos; Optics and Lasers in Engineering; Accepted; (2018).
- [3] "Digital holographic microscopy as a technique to monitor macrophages infected by leishmania"; E. Mendoza-Rodriguez, C. Organista-Castelblanco, M. Camacho, F. Monroy-Ramirez; Proceedings of SPIE, Optical Metrology; Munich, Germany; (2017).



Freddy Alberto Monroy-Ramirez

Doctor in Physical Sciences the National University of Colombia with the thesis titled Digital Holographic Microscopy of phase objects. The main topic of research of Professor Monroy has been framed within the Digital Holography Microscopy (DHM), the micro-holo-tomography (a technique that combines DHM with tomography) and lately, has explored in other phase quantification techniques, such as diffraction phase microscopy and point diffraction interferometry. Among the most important applications in which he has directed his research are palynology, working with mouse peritoneal macrophages and diagnosis of Brazilian Leishmania, as well as he has focused on the study of blasts in human peripheral blood, to diagnostic acute lymphocytic leukemia. Currently, he is an associate professor in the Physics Department of the National University of Colombia in Bogotá.

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