New holographic module for digital holographic microscopy for obtaining quantitative phase imaging of samples without stain

VNIVERSITAT DE VALÈNCIA

Microscope, method and computer program for obtaining quantitative study of transparent samples by digital holographic microscopy

I+D RESULT

Patent

Knowledge area

- Health. Biomedicine
- Biology
- Materials

Collaboration

- Technology available to licensing
- Other collaborations may be considered

Ref.
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Background:
In the field of biomedicine, quantitative phase measurement of unstained samples is of great interest because it allows the quantitative study of transparent samples. Currently, there are some commercially available holographic microscopes that perform such measurements. However, these commercial devices do not show the image of the sample in real time. Instead, they provide the reconstructed images only after the subsequent numerical processing. This is an important drawback, because the users cannot see the sample while recording the hologram, and therefore they have not certainty of been focusing the right section. In addition, holographic modules currently marketed capture images with aberrations and low resolution. The present invention overcomes these problems. It allows the quantitative phase measurement in real time of the specimen. It eliminates the phase curvature aberration and reaches the diffraction limit dictated by the host microscope.

The invention:
Researchers at the University of Valencia, in collaboration with the National University of Colombia, have developed and patented a device based on the use of digital holographic microscopy (DHM) which uses telecentric couplings and image plane detection. This novel invention can be adapted to a conventional optical microscope to obtain quantitative phase images of samples without staining in real time, without aberrations and with good resolution. A potential application of this technique is the accurate measurement of possible morphological changes in erythrocytes, and therefore the detection of pathologies that produce such effects as, for example, type 2 diabetes mellitus (DM2).
The DHM technique makes it possible to differentiate between people affected by DM2 and those not affected, by means of a differential analysis of the alterations in the distribution of phase maps using DHM in erythrocytes. The potential of this technique as a diagnostic tool is due to its minimally invasive character, requiring only a small drop of capillary blood, and because it can be performed at any time, obtaining results almost in real time. It is a wide field technique that can be easily implemented in a conventional microscope, which means that its production is economically viable. In addition, could also be used in the future to analyze diseases in which the refractive index and/or cell morphology are distorted.

Applications:
Various sectors of bio-sciences, materials science, and where it is not possible or not desired tint the specimen under study. The DHM device is designed for use in small hospitals, clinics or health centers and entities such as NGOs that need fast, mobile and accurate diagnostic units.

Advantages: The main advantages provided by the invention are:

- Rapid detection of patients with DM2 or other diseases with altered cell morphology.
- Quantitative phase measurement in real time for samples without stain.
- Reduced costs.
- Minimization of optical aberrations
- Possibility to operate in mode of quantization of phase image or in modes offered by host conventional microscope.
- Friendly use of the software.
- Resolution dictated by the host microscope
- Minimization of numerical noise in the processing of the holograms recorded.