Wave-optics analysis by the phase-shifting real-time holographic interferometry

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The most important components of optical imaging and optical data processing systems are the lens or lens systems. A wave-optics analysis of the lens is in accordance with the geometrical optics theory, with the additional advantage that in the wave-optics approach are completely accorded for diffraction effects. The interferometric methods are typically used in wave front analysis for lens and imaging quality evaluation. Two-beam interferometers have been used for the testing of optical components and optical systems. They present many advantages over other test methods: it is usually non-contact and does not damage fragile optical surfaces; in most cases, the interference fringe patterns are diagnostic of the errors in the test piece and are easily interpreted; the quantitative and qualitative analysis in wave front aberrations; further, can be null tests. The Twyman-Green and Mach-Zender are the most popular interferometers in classical wave aberration measurements. For the other hand, the holographic interferometry techniques are powerful optical methods for wave front analysis in the field of non-destructive testing. In recent years, the use of the photorefractive sillenite crystals as holographic recording medium has added a new dimension to holographic interferometry since the writing-reading hologram process is made in real-time. In this direction, the phase-shifting real-time holographic interferometry technique (PS-RTHI) using sillenite crystal consist in capture of holographic interferograms in real-time and in the interferogram analysis by spatial phase measurement: the phase-shifting technique. So, the possibilities of the use PS-RTHI in optical testing can be a interesting applications of this technique, where its possible to obtain the intensity and phase distribution from the wave front in any arbitrary plane located between the optical element and the recording plane. Quantitative determination of the wave front phase allows investigation of the modifications suffered by the wave front through phase-distorting media: optical elements and systems, lens with aberrations or ground-glass screen, non-linear optical materials and other cases. In this work, we describe a phase-shifting real-time holographic interferometer using photorefractive sillenite crystal as holographic recording medium, which is suitable for performing quantitative measurements in lens from the intensity and phase distributions of the wave front for different locations along the propagation direction in real-time. Also, we introduced, for first time in our know, the potentialities of this technique to study light-induced lens effect in nonlinear optical materials with visualization, monitoring and analysis in real-time.