Transportable holographic interferometer uses photorefractive crystals for industrial applications

Photorefractive crystals (PRCs), and particularly those belonging to the sillenite family \([\text{Bi}_2\text{SiO}_5, \text{Bi}_2\text{GeO}_4, \text{Bi}_2\text{TeO}_4, \text{Bi}_2\text{TeO}_4(\text{BTO})]\), are increasingly promising recording media for holographic interferometry. Classical plates are much more sensitive than PRCs, but they need chemical processing requiring liquid bridges when in situ recording. Postphotorefractive have a sensitivity comparable to PRCs and can be processed in situ by electrical and thermal processes. However, although they can be erased, the number of exposures is limited. Postphotorefractive crystals are also much larger, allowing the use of good quality sillenite crystals, powerful compact lasers, and sensitive, commercial CCD cameras, which allows us to overcome these difficulties.

At first glance, these advantages are counterbalanced by the relatively weak sensitivity of sillenites. This difficulty, combined with a weak diffraction efficiency and optical dimensions of crystals limited to the cm level, meant that experimental prototypes of PRC interferometers were confined to laboratories where powerful lasers were available. However, the recent availability of much larger good quality sillenite crystals, powerful compact lasers, and sensitive, commercial CCD cameras, has allowed us to overcome these difficulties. Here we discuss an interferometer that was designed to be compact (up to a breadth, easily transportable, able to image objects of about \(50 \times 50 \text{ cm}^2\), and which made possible the taking of quantitative measurements.

The development and optimization of the system are presented elsewhere. \(^3\) Real time holographic interferometry is performed referring to an object beam and a reference beam. The object beam is directed to the crystal, and the reference beam is directed to the photorefractive crystal. The photorefractive crystal is then used to modulate the object beam. The object beam is modulated in the photorefractive crystal and then imaged onto a sensor, typically an optical head design.

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Directly performed stroboscopic readout is synchronous with the excitation of the object beam and the reference beam. The object beam is modulated in the photorefractive crystal and then imaged onto a sensor, typically an optical head design.

Figure 1. Schematic of the photorefractive holographic camera.

Figure 2. Industrial applications of the holographic camera. (a) Defect detection in aerostructural composite panels. (b) Differentiated phase for easy defect localization. (c) Vibration mode of a turbine blade (phase interferogram).

References


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Possibilities


