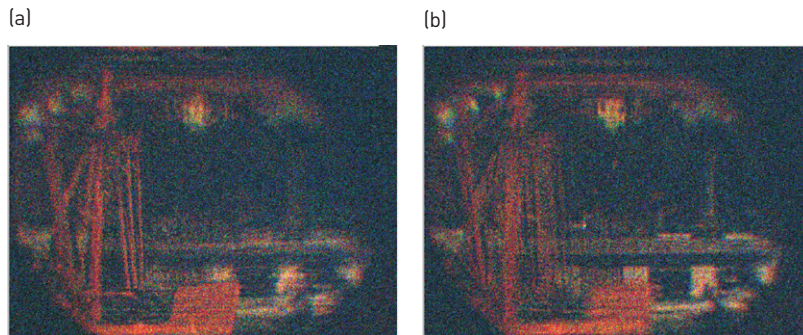


Holographic Camera Uses Full-Color Natural Light

Holography has widespread influence in many areas of technology, from metrology and biomedical imaging to fine arts and entertainment. But holography's coherent light requirement presents a serious constraint for a wider range of applications.¹ With coherent laser illumination, holographic 3-D imaging would not be as easy and mundane as basic photography.

Many researchers have tried to record holograms under incoherent illumination, but most of their methods have limited degrees of practicality. However, a recent development called Fresnel incoherent correlation holography (FINCH) shows promise. FINCH is based on self-interference between two copies of a spherical wave from each source point, using a spatial light modulator as a combination of curved and flat mirrors.² I proposed an incoherent holography scheme for adaptive optics called self-interference incoherent digital holography (SIDH). SIDH measures and compensates for aberrations using only holographic processes—removing the need for wavefront sensors or deformable mirrors.^{3,4} The technique is being developed for potential applications in astronomical and ophthalmic imaging.

SIDH is based on a modified Michelson interferometer with two mirrors of different curvatures and can be used to generate full-color 3-D images of naturally lit outdoor scenes.⁵ First, a color CCD camera acquires the interferograms. Next, the three color channels are separated and analyzed individually



Two frames from the movie show a close toy boat (a) and distant buildings (b) focused with the self-interference incoherent digital holography scheme.

to obtain the red, green and blue component holograms. The resultant amplitude images are then combined to produce 3-D full-color holographic images of daylight-illuminated outdoor scenes. The 3-D content of the holographic image is demonstrated by numerically focusing to different distances. This may be the first recording of outdoor scenes under daylight illumination using a holographic process.

Incoherent digital holography techniques like SIDH open up a wide range of new applications and capabilities for holography because they remove the serious constraint of coherent lasers as illumination sources. One can expect applications in all areas of imaging such as astronomy, remote sensing and fluorescence imaging, as well as in non-optical wavelengths such as X-ray imaging. **OPN**

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