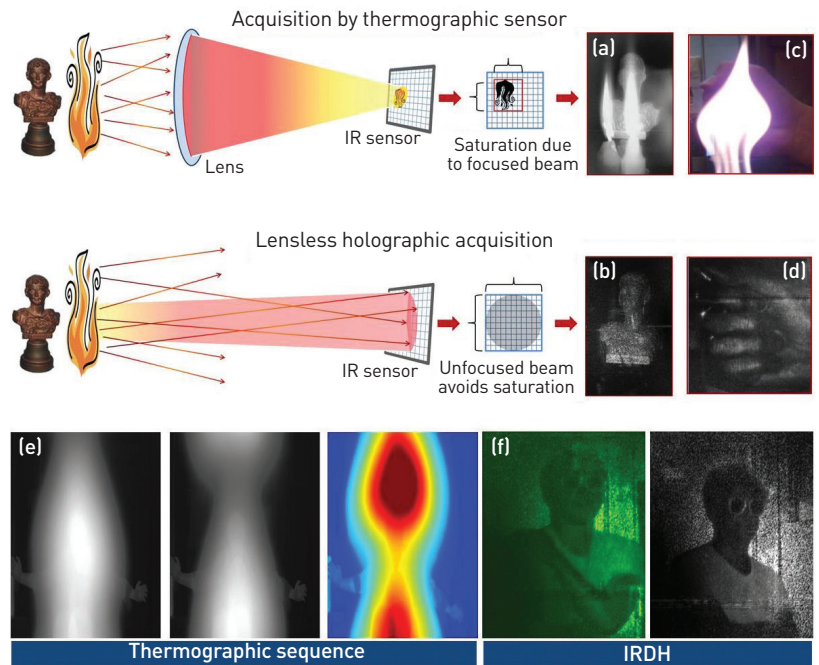


## HOLOGRAPHY

# Lensless Digital Holography Improves Fire Safety

House fires cause thousands of deaths every year.<sup>1</sup> Firefighters and first responders are called on to work in these hostile environments where their vision is impaired due to curtains of smoke and walls of flames. They can use thermographic cameras equipped with infrared radiation (IR) bolometers to see through the smoke because IR is only slightly scattered by smoke particles, allowing for a clear view of the scene. However, rescuers cannot use IR bolometers to detect a target hidden behind fire because their eyes are blinded by the flame's emission. Radiation from the fire is conveyed onto some of the IR bolometer's sensor detector elements, thus provoking their saturation. As a consequence, the useful signal cannot be discerned and gets lost.

IR digital holography (IRDH) could provide firefighters and first responders with a way to see through fire. IRDH allows the user to record holograms out of the focus plane with a lens-free setup and perform the numerical focusing afterwards.<sup>2,3</sup> Thus, the flame-emitted radiation is scrambled over the whole sensor area, avoiding saturation. At the same time, the coherence of this holographic approach definitively helps the imaging process.<sup>3,4</sup> The maximum size of the objects that can be imaged with IRDH is proportional to the source wavelength at any fixed target-sensor distance. Therefore, an IR laser source working at 10.6  $\mu\text{m}$  can produce a holographic recording



Schematic of the classical approach making use of IR bolometers, compared with lensless IRDH. (a) Thermographic image of a metal object through candle flame. (b) DH reconstruction of the object. (c) White light image of a man's hand through stove flames. (d) Clear infrared radiation DH reconstruction of the hand through the flames. (e) Thermographic images of a man standing behind a flame. (f) DH reconstructions of live humans, clearly visible through flames generated in (e).

of a live human moving behind a flame.<sup>3</sup> The adopted wavelength also makes the recording process much less sensitive to vibrations so that the IRDH device can be brought out of the laboratory and into the field.<sup>5</sup> In the future, firefighters and first responders could use IRDH tools to get a clearer view of the scene and hopefully save more lives during their dangerous rescue operations. **OPN**

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