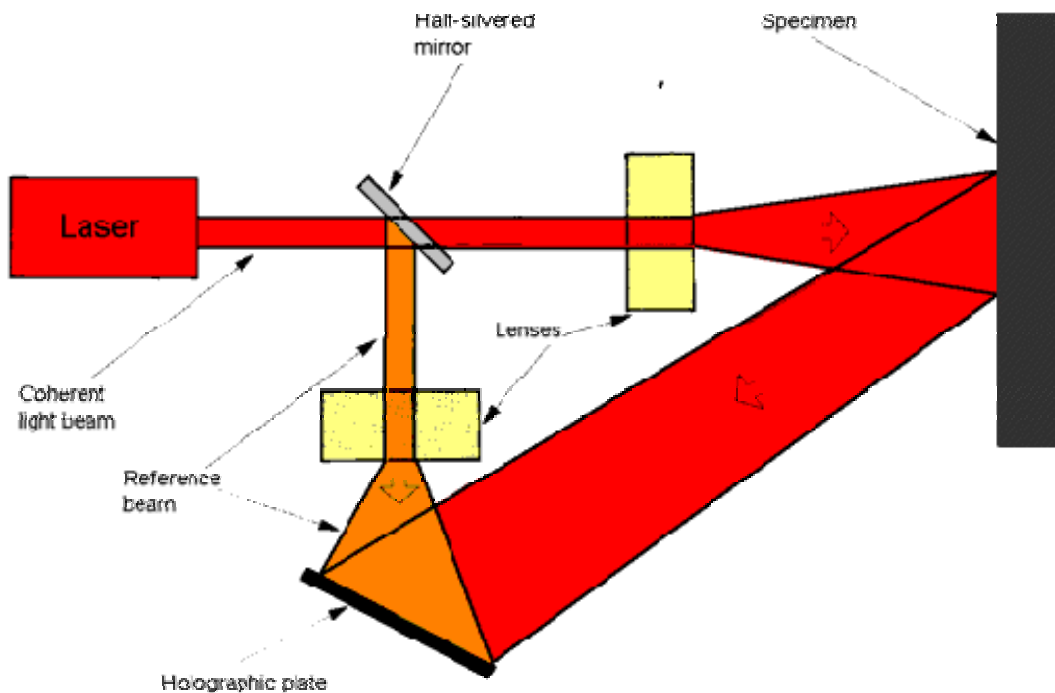


Introduction to Optical Holographic NDT

Optical holography for surface deformations



Optical Holographic techniques can be used for nondestructive testing of materials (HNDT). Non-optical Holography techniques include Acoustical, Microwave, X-Ray and Electron beam Holography. HNDT essentially measures deformations on the surface of the object. However, there is sufficient sensitivity to detect sub-surface and internal defects in metallic and composite specimens.

In HNDT techniques, the test sample is interferometrically compared with the sample after it has been stressed (loaded). A flaw can be detected if by stressing the object it creates an anomalous deformation of the surface around the flaw.

Optical holography is an imaging method, which records the amplitude and phase of light reflected from an object as an interferometric pattern on film. It thus allows reconstruction of the full 3-D image of the object. In HNDT, the test sample is interferometrically compared in two different stressed states. Stressing can be mechanical, thermal, vibration etc. The resulting interference pattern contours the deformation undergone by the specimen in between the two recordings. Surface as well as sub-surface defects show distortions in the otherwise uniform pattern. In addition, the characteristics of the component, such as vibration modes, mechanical properties, residual stress etc. can be identified through holographic inspection. Applications in fluid mechanics and gas dynamics also abound.

The light used to illuminate the surface of the specimen must be coherent, which means that it must also be monochromatic, and the only practical source is a laser. Each type of laser emits a characteristic wavelength, e.g. a helium-neon laser emits 632.8nm; a ruby laser emits 694.3nm. Laser diodes are nowadays an exciting and compact alternative. Indeed, holography using laser pointers have also been demonstrated.

High-resolution films are another necessity for holography. With the advent of CCD and digital image processing, digital holographic interferometry offers tremendous flexibility and real-time visualization. Furthermore, image-processing schemes can provide computerised analysis of patterns for automated defect detection and analysis.

Finally since intricate interferometric patterns have to be recorded, vibration isolation is also required. Novel schemes have been proposed, including use of pulsed lasers to record holograms in factory environments.

Advances and developments in lasers, computers, and recording materials introduce new techniques

such as electronic (or TV) holography, multi-wavelength recording, thermoplastic medium, time-averaged holography, dynamic holographic interferometry, cineholography, and digital holography with each new development. Methods that once held only academic interest often become practically viable with these developments in hardware and software.

HNDR is widely applied in aerospace to find impact damage, corrosion, delamination, debonds, and cracks in high performance composite aircraft parts as well as turbine blades, solid propellant rocket motor casings, tyres and air foils. But Holography is also finding new applications in commercial and defense related industries to investigate and test object ranging from microscopic computer chips and circuits to cultural articles, paintings and restoration.