Holography Underwater Inspection

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ABSTRACT

In this work, the under-water inspection processes are focused. The difficulties during the process and the quality of the image generated are the main concern for bodies in the ocean deep water. The holography is proposed as an under-water inspection process and its advantages and disadvantages are compared to the other more common used processes. The fundamental theoretical aspects of holography are discussed and the relevant influence of the water over physical behavior laser beam are theoretically considered in the analysis.

The experimental analysis is done by recording holograms of a steel plate submerged into water. In order to create a fixed standard image hologram, the steel plate was submitted to a load generating interference bands, when the double exposure technique was used.

In order to investigate the effect of the water over the resolution of the interferogram, it was used distilled water, sea water, drinking water and tap water, and also compared to the interferogram taken in the air, under the same loading condition. The values of the displacements obtained in air and underwater are compared.

The images were processed by using the Global Lab. Software. The software, analyzing the interference bands, gives information about band resolution per “mm”, average resolution for the full amplitude, the distribution of the bands along the interferogram, the separation between bands, a graphical recording of the bands intensity, the width of bands and the fringe pattern recording.

INTRODUCTION

In the industries gas and oil close to the coast, the quality inspection of the underwater facilities, most of the times have to be carried out with little visibility and in conditions potentially risky. When the depths increase, the difficulties also increase and more emphasis is placed in the remote inspection, instead of the diver. The optical methods traditionally used, such as the conventional picture, stereo-picture and videography, suffer the inconveniences possession of a moderate resolution, tridimensionality lack, loss of information due to the effect of parallax distortion of the perspective and limited field depth.

Systems using videos and digitalization of the holographic image, known as Electronic Holography, have already demonstrated its capabilities for measuring vibrations and lower levels of deformations in conditions that were unables through the traditional holographic techniques. The Electronic Holography made possible the measurements in situations of difficult access as well as in underwater situations. The great potentiality of holography in underwater situations is the possibility to using it in inspection areas and submarine measurements.

The simulation in laboratory of the underwater conditions that happen in the ocean is the best form of solving the problems that avoid the full use of the submarine holography.

PHENOMENOLOGICAL DESCRIPTION OF HOLOGRAPHY

The optical holography is a technique constituted by three main stages: formation, photographic processing and reconstruction. In the phase of formation of the hologram the involved basic physical phenomenon is the interference among luminous waves; a luminous wave is completely described through data about amplitude and phase, which, when registered in photographic material of excellent resolution, represent an object in its totality. The information on the illuminated object can be obtained through separation of the light coming from the source into two rays: the ray object, which illuminates the object, being by it diffracted and the reference ray that comes directly from the source preserving the phase information and for this reason it allows the volumetric recovery. The interception of those rays on holographic plate constitutes an interference pattern formed by clear and dark fringes that contains all the object information.

After of above processing (recording) the material is revealed and fixed and it's submitted to a phase of holographic reconstruction. In that moment the registration of the interference fringes is illuminated with a similar wave to the one that it was used