PRECISION INSPECTION OF FLATNESS BY MOIRÉ INTERFEROMETRY

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ABSTRACT
The automation, speed and precision in the quality control of surface shape require the development of control methods suitable for this purpose. The technique proposed in this paper provides a quality control components surface flatness by non-destructive and contactless way, with high resolution and increased sensitivity. The control is done in real time and instantaneously on all inspected surface. The accuracy of components geometry is the one of parameters which influences precision of the function.

Keywords: Optical techniques, moiré interferometry, surface flatness.

INTRODUCTION
Moiré topography is a full-field optical technique in which the shape of object surfaces is measured by means of geometric interference between two identical line gratings. The technique has found various applications in diverse fields, from biomedical to industrial and scientific applications. In many industrial metrology applications, contactless and non-destructive shape measurement is a desirable tool for, quality control and contour mapping. The method of optical scanning presented in this paper is used for precision measurement deformation in shape or absolute forms in comparison with a reference component form, of optical or mechanical components, on reduced surfaces area that are of the order of 100 mm² and more. The principle of the method is to project the image of the source grating to palpate optically surface to be inspected, after reflection; the image of the source grating is printed by the object topography and is then projected onto the plane of reference grating for generate moiré fringe for defects detection. The optical device used allows a significant dimensional surface magnification of up to 1000 times the area inspected for micro-surfaces, which allows easy processing and reaches an exceptional nanometric imprecision of measurements.

According to the measurement principle, the sensitivity for displacement measurement using moiré technique depends on the frequency grating, for increase the detection resolution. This measurement technique can be used advantageously to measure the deformations generated by the production process or constraints on functional parts and the influence of these variations on the function. The optical device and optical principle, on which it is based, can be used for automated inspection of industrially produced goods. It can also be used for dimensional control when, for example, to quantify the error as to whether a piece is good or rubbish. It then suffices to compare a figure of moiré fringes with another previously recorded from a piece considered standard; which saves time, money and accuracy. This optical device control has advantageous features allows non-destructive and contactless testing, real time speed inspection and measurement; possibility of image tracking in motion analysis and surface deformation, high spatial resolution and high sensitivity may vary depending of the importance of defects to be measured.
PRINCIPLE AND OPERATION OF EXPERIMENTAL SETUP

The Laser beam HeNe 35mW emitted by the source S, and slightly expanded by the lenses system (L1,L2) depending on the inspected surface, and illuminates linear transmission grating G1, Figure 1. After crossing the grating G1, the light beam is diffracted by a set of divergent rays that pass through the lenses system (L3, L4) which realised the double Fourier transformation for to project the grating image G1 on the plan mirror M of high quality surface. The grating G1 image is reflected by the mirror M on the grating G2 plan, where it is optically superimposed on the linear transmission grating G2. Gratings G1 and G2 are identical and have same spatial frequency. In this case, the superposition of the grating image G1 on the plane of grating G2 is carried out by optical way, for the purpose, to eliminate various influences on image quality of moiré fringes. The grating G2 is installed on single holder, who is held on rotary mount which can rotate about of optical axis for adjustment of the angle between the grating rulings. The grating G2 is slightly rotated by optical axis by small angle Θ near zero degree; moiré pattern is formed on plane of grating G2. The generation of moiré fringes system, by crossing of rulings gratings G1 and G2, consist of parallel bands alternately bright and dark, they are projected by the lenses system (L5, L6) on the observation plane OP, where the CCD camera is positioned and connected to the computer for automatic data processing.

Fig. 1 - Optical principle of experimental setup  
Fig. 2 - Moiré fringes of plan mirror flatness less λ/4

REFERENCES