Surface shape measurement by digital phase-shifting moire profilometry

Non-contacting electro-optical techniques are finding an increasing range of applications in the measurement of surface shapes, ranging from machine parts to the human body. In one technique a grid pattern is projected on the surface to be measured and the resulting deformation of the pattern is evaluated. Early work in this field relied on subjective visual evaluation or laborious manual analysis of the grid pattern. Now, digital image processing techniques developed at DAP offer rapid, automated evaluation of surface topography.

A typical set-up for digital phase-shifting moire profilometry is shown schematically in figure 1. As shown, a sinusoidal grating pattern is projected on the surface to be measured. The pattern can be generated photographically on a suitable photosensitive medium or interferometrically. In the system shown, the pattern can be translated or shifted by moving a mirror mounted on a piezoelectric transducer (PZT) under computer control. The spacing of the pattern can also be controlled to vary the sensitivity by tilting the beam splitter to change the angle between the two interfering beams.

The deformed image of the pattern is viewed by a TV camera. The output of the TV camera is fed to the computer where it is digitized to a 512x512x8 bit image. The deformation of the pattern is evaluated by recording a number of images with the pattern translated by a predetermined amount between successive recordings. To obtain the surface relief of the object the deformed image is compared in the computer with the undeformed pattern. The results can then be plotted as a 2-D pseudocolour contour map or as a 3-D profile plot.

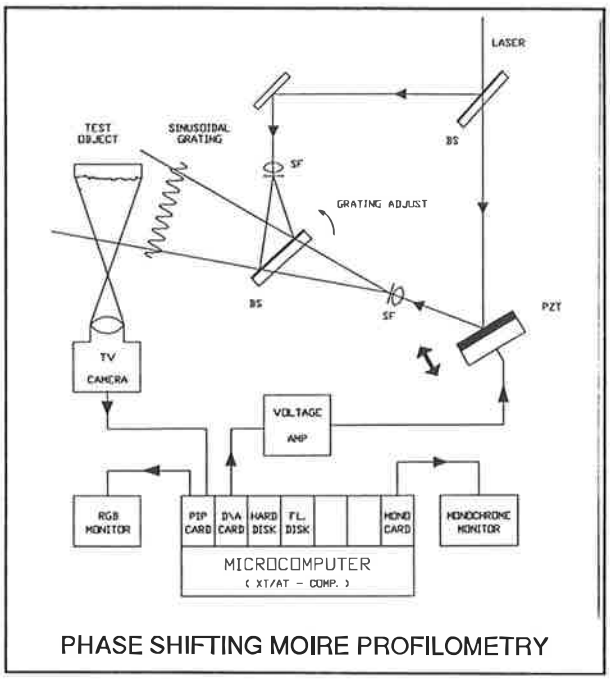

Figure 1.

Figures 2 and 3 show some results of measurements of the surface shape of a dollar coin.

Once the system is set up, a set of images can be acquired in less than a second and processed in a matter of minutes, giving accurate shape data at up to 512x512 points over the surface of the object. A wide range of object sizes and shapes can be measured with high accuracy.

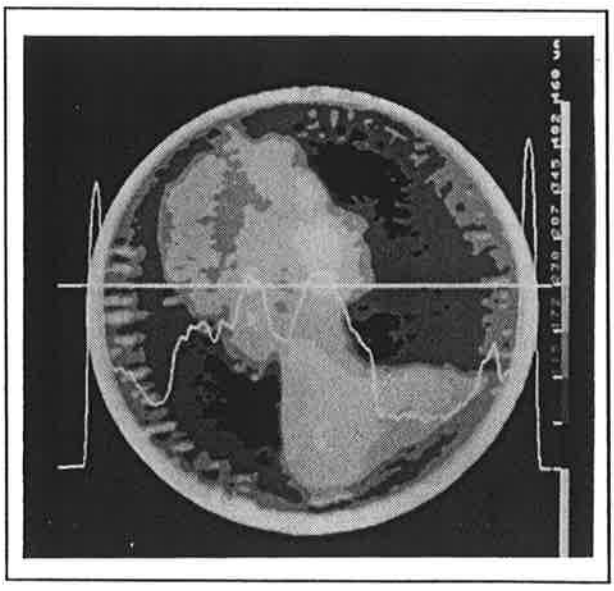

Figure 2.

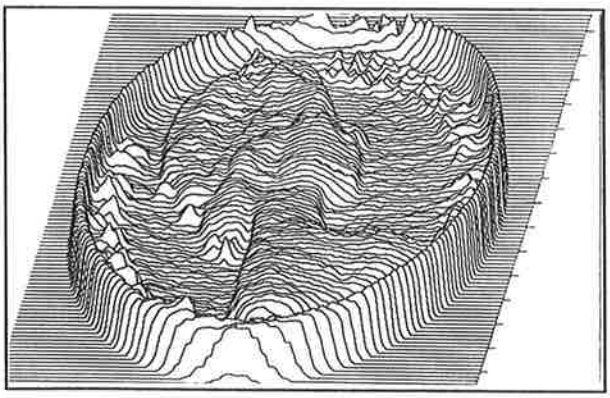

Figure 3.

Enquiries from potential users and those interested in this technology will be welcomed at:

Optical Technology Group
CSIRO Division of Applied Physics
PO Box 218, Lindfield, NSW, Australia 2070
Telephone (02) 467 6211
Telex AA 26296 Fax (02) 467 1902

CSIRO
AUSTRALIA