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FAULT DETECTION IN NON-DESTRUCTIVE TESTING BY AN OPTO-ELECTRONIC HYBRID PROCESSOR

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Introduction

In non-destructive testing, interferometric methods play an increasing role especially as they are entering the field of quality control in mass production. An evaluation system for interferograms designed for such applications has to perform a typical pattern recognition process: Faults, e.g. in parts of machinery, resulting in characteristic interference fringes have to be detected leading to the desired "go" or "no go" statement.

System philosophy

The coherent-optical preprocessing allows fast and artefact-free data acquisition and feature extraction from the photographically stored input. A linear time-varying bandpass filter serves as a local 2D spatial frequency analyzer. The preprocessor provides the sequential display of local spacing and orientation of the interference fringes which stand for the magnitude and direction of the gradient of mechanical surface deformations. After opto-digital conversion a maximum detection mechanism leads to a single data-array containing the mentioned features. The analog preprocessor allows data reduction factors of up to 3000 and works on a great variety of input images without alteration.

The final computing is done by a conventional digital microcomputer also serving for the control of the opto-digital conversion and the frequency analyzer as sketched in fig.1. The algorithms mainly consist of local neighborhood comparison operations and a final threshold operation according to a given criterion. The flexibility of the digital section allows easy alterations of the classification criterion.

Realized Processor

The optical preprocessor has a typical processing capacity of about 8 Mbit. The input data for the digital section is only 2.56 kbit and the total processing time for one interferogram is typically less than 15 seconds. Figure 2 shows an interferogram of a metal plate having three welded joints on the backside. These three areas should be detected. Figure 3 shows the result: Inserted marks indicate the automatically recognized regions.

Literature

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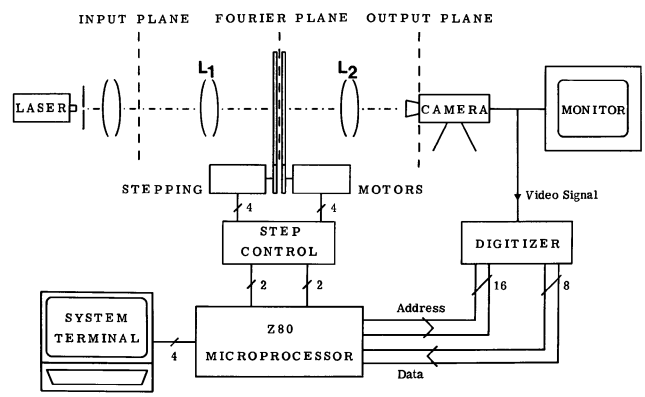

Fig.1: Complete hybrid processor.
The stepping motors drive two filter components forming the analyzing bandpass function

Fig.2: Interferogram (input function)

Fig.3: Automatically detected irregularities (notice, different scale!)

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