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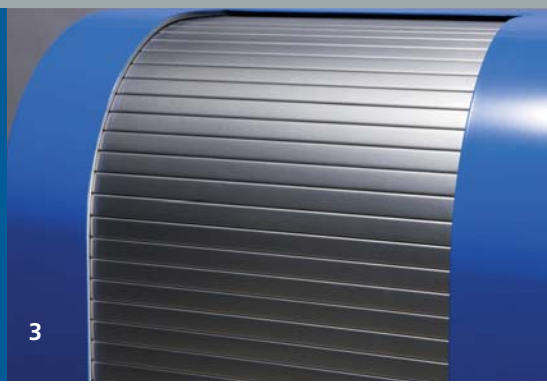
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1 *Detail of the control panel.*
2 *Interior of the inspection system.*
3 *Exterior of the inspection system.*

OBJECTIVE INSPECTION OF MARKING QUALITY

Fraunhofer Institute for Factory Operation and Automation IFF

Prof. Michael Schenk

Sandtorstrasse 22
39106 Magdeburg, Germany

Contact
Measurement and Testing Technology
Business Unit
Dr. Dirk Berndt
Tel. +49 391 4090-224
dirk.berndt@iff.fraunhofer.de

Ralf Warnemünde
Telefon +49 391 4090-225
ralf.warnemuende@iff.fraunhofer.de

www.iff.fraunhofer.de

OPTOINSPECT 3D Measuring Device

Overview and Motivation

A marking's quality is characterized by a number of subjective impressions. Variances in the production process often considerably influence not only readability but also a product's overall impression. An inspection is essential whenever consistently high quality must be ensured. Important quality evaluation criteria of a marking are the attributes of completeness, contrast, sharpness and homogeneity. The results of quality evaluations by inspectors are subjective.

The Fraunhofer IFF in Magdeburg has developed a new image-based system that makes it possible for the first time to automatically and objectively inspect the important attributes of marking quality. In an application for small components, the system was integrated in a mobile inspection unit and used both for sampling tests and inspection in receiving. The inspection unit's flexible adjustability allow inspecting a wide range of test specimen shapes.

System Features

- Patented system that objectifies and standardizes hitherto subjective quality inspection
- Evaluation of completeness, contrast, sharpness and homogeneity
- High flexibility by specifying the inspected marking as a vector graphic
- A golden sample and teaching time are unecessary
- Certified repeatability and reproducibility (Gage R&R tests)

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State-of-the-Art

Already existing marking inspection systems compare the test specimen with a selected perfect template. This is required for every test specimen or marking and must be taught into the system. Integrated OCR software enables character recognition. However, this is often no longer sufficient for modern systems and customers' demands for steadily increasing quality.

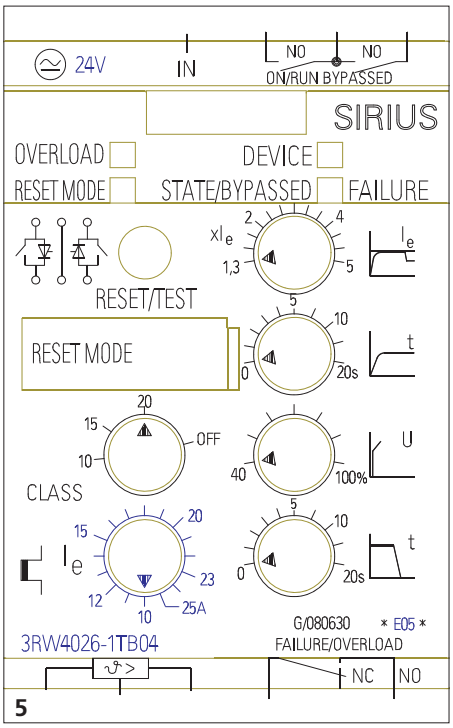
Unlike existing systems, this patented system employs a complex multi-dimensional feature space of contrast, homogeneity, completeness, lettering/edge width, each with different weighting, thus reproducing the perception of subjective quality.

The Functional Principle

The completeness, contrast, edge width and sharpness and homogeneity of every element of a marking are tested to evaluate the quality. The criteria have been derived from the physiology of human perception and objectively reproduce the subjective impression of quality. The inspected marking is specified by vector graphics, thus making it highly flexible when inspecting small lot sizes with high variation. The algorithm that evaluates marking quality functions on the basis of on contour, i.e. it does not matter whether targets are letters, characters or other symbols. The target marking is first reconciled with the test specimen's actual image to recognize and evaluate the individual elements.
To do so, the image elemente are automatically selected and disturbing influences such as the camera lens's distortion are corrected. Then, a best fit algorithm positions the processed test specimen's image elements over the target image. In the process, the translation, rotation and scaling between target and actual contours are measured and aligned. Thus, between the measured and the predefined elements can be directly compared and differences easily detected. Finally, the inspection software visualizes and documents the results. The repeatability and reproducibility demonstrated by Gage R&R tests makes the measurement system also implementable to monitor and optimize different manufacturing lines and to monitor the long-term stability of various materials.

The Inspection System

The inspection system's hardware components have been designed and engineered for ergonomic and easy manual operation. The system includes a high-performance camera and light array that enables it to operate regardless of ambient influences. The inspection unit is compact and transportable and can be operated with an ordinary laptop, thus making it usable at the workplace at different locations in manufacturing. The system can be modified to fully automate the inspection process.



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4 Complete system and color coded visualization of the result of inspection per element, from green (good) to yellow to red (bad).
5 Inspected elements specified as a vector graphic.
Photos: Bernd Liebl