

Inspection of Hollow Cavities

Inspection of long drill holes

Safety-relevant components and assemblies

Integration of measurement mechanics into the customer-specific manufacturing environment

Gesellschaft für Bild- und Signalverarbeitung mbH
(Association for Image and Signal Processing, a German limited liability company)

Gustav-Kirchhoff-Straße 5
D-98693 Ilmenau
Tel. +49 (0) 3677 2010 303
Fax +49 (0) 3677 2010 302
Email info@gbs-ilmenau.de
Web www.gbs-ilmenau.de

General Manager:
Dipl.-Ing. T. Machleidt

In cooperation with:



Zentrum für Bild- und Signalverarbeitung e.V.
PD Dr.-Ing. habil. Franke
Chairman

Field of application

The most important field of application is the inspection of the walls of long drill holes in cast parts made of steel, aluminum, and other metals. Special safety engineering equipment, such as pressure cylinders and bushings, manufactured in non-failure-free processes (as is the case for instance in aluminum die casting) must be 100% inspected. This task can only be effectively carried out with automatic inspection. We offer users a complete stand-alone measurement system, tailored to drill hole inspection. We also carry out the integration of the measurement assembly in customer-specific manufacturing processes and production facilities. The system was designed for industrial use, taking into consideration aspects of inspection reliability, cost effectiveness, and robustness.



Fig. 1: Typical parts to be inspected

Measurement assembly

The measurement system is based on a conical mirror that travels through the drill hole. Outside the drill hole, a camera records the surface of the hole wall, section by section, from the direction of the tip of the cone. Illumination is provided by a diffuse light source, illuminating the hole wall near the mirror. The mirror and light sources have been constructed as a compact assembly. The camera/lens and mirror/illumination assemblies are mounted a fixed distance apart from

each other on a carriage. A linear motor unit drives the carriage; after positioning the part to be inspected



Fig. 2: Measurement assembly in automatic inspection machine, duplicate arrangement, aluminum foundry Erlau

in the measurement station, the mirror and illumination are introduced into the drill hole and advanced through it. The use of standard components for image acquisition (camera and lens technology), image processing (standard PC), and handling (traversing unit) guarantees cost effectiveness. The special mirror and illumination components were designed by our optics specialists. They can be adapted to the customer's needs.

Software

The core of the case-specific application is the VIP Toolkit program system, developed at our company. VIP is an extensive algorithm library for image processing. The structures necessary for image processing have been designed and optimized in this software package. We structure the human-machine communication according to your needs, in a customized user interface. Our services include the configuration of product-specific defect classification.

In the described application, the advance of the linear unit is synchronized

with the rate of image acquisition by the camera. This ensures the acquisition of seamlessly aligned images.

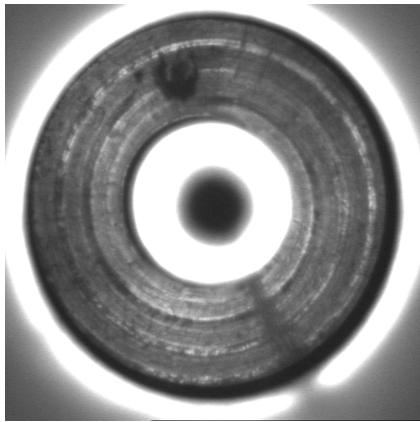


Fig. 3: Concentric panorama image

The distortion in the concentric panorama images of the surface bands is corrected with a geometric transformation, resulting in square images of the wall regions.

A subsequent brightness balance compensates fluctuations in the illumination of the image field. The corrected individual images are arranged sequentially and depict the state of the entire drill hole wall.

The detection of surface defects takes place using grayscale analysis procedures. Surface defects such as shrink holes, pores, and processing defects are detected. The program classifies defective areas into user-specific defect classes, according to shape, size,

and severity. Typical processing traces, such as grooves and ridges, are tolerated by the software and not interpreted as defects. The software visualizes and logs the defects and analyzes them statistically. We carry out a customer-specific configuration of defect types and error limits.

The software runs on all current Windows operating systems. It can be installed on a standard PC or an intelligent compact camera. The results of a sorting decision are outputted to digital outputs, to operate switches or signaling units and to communicate with the machine control system. If desired, the defects can be saved in EXCEL format, according to type and frequency.

Parameters

The smallest drill hole diameter that can be inspected is 10 mm. The measurement accuracy depends on the size of the selected measurement area. The defect to be recognized should be imaged by approximately 3 x 3 sensor pixels. Today's standard cameras feature sensors with 752 x 582 pixels. The circumference of one of the middle rings in the previous panorama image is approx. 600 pixels. This means that with a standard camera, a defect of approximately 1/200 of the desired measurement field (cir-

cumference of the drill hole) can be resolved. In the case of a hole diameter of 20 mm (circumference approx. 60 mm), defects as small as 0.3 x 0.3 mm can be reliably detected. With modern, high-resolution cameras, even smaller defects can be recognized.

The inspection of the depicted 90 mm-long bushing was implemented on a round indexing table with a cycle time of 3 seconds. The measurement system was installed in duplicate, so that two bushings can be inspected in parallel. The cited cycle time includes the time required to place and remove the bushing, pass through the drill hole, and reset the drive.

Range of services

Planning and design of measurement technology solutions

Design of components

Realization of the equipment for the measurement assembly

Programming of the inspection sequences

Design of the human-machine interface

Integration into the customer's manufacturing environment

Classification of defects

On-site installation and operational startup

Operator training and service

Reference applications

Aluminum foundry Erlau,
Hildburghausen/Germany

Inspection of bushings

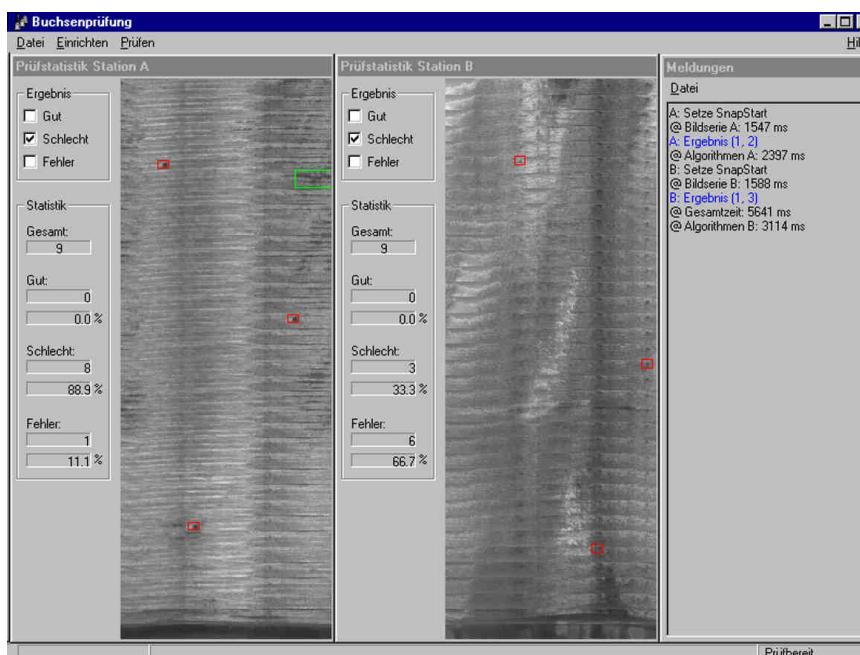


Fig. 4: User interface depicting the inside surface, defects highlighted